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Routes for the New York Rapid Transit Ry. were formally adopted at a meeting of the commission on Feb. 16. The route consists of a main line on Broadway from the Battery to 59th St., and thence via the Boulevard to 169th St.,and thence under 11th Ave. to 185th St. The East side line is to diverge from the main line at or near 14th St., and run under Union Square, Fourth and Park Aves. to 98th St.,and thence by viaduct on Park or Fourth Ave. to the Harlem River. Above the Harlem the line is to extend to the center line of Walton Ave., produced at or near its intersection with 138th St., and thence along Walton Ave. to 146th St. Both the East side and West side lines must be extended to the northern boundary of the city as soon as practicable. A resolution covering a general plan of construction was presented, but vote upon it was postponed.

Bids for building the first section of the Boston Subway are called for this week, as noted in our advertising columns. This section is located in the Public Garden, across Charles St., and along the Boylston and Tremont St. malls of the Common.

Construction was commenced on Feb. 19 at Somerville, N. J., on 5 miles of the projected New York & Philadelphia Traction Company's electric railway. This line is to connect Somerville and Bound Brook with New Brunswick, and it is to be completed by April 10 next. The company will use combination cars on the route for carrying farmers' produce in this agricultural district.

Bids for three torpedo boats were opened at the Navy Department on Feb. 19. These proposals were for the construction, exclusive of armament and torpedoes, of metallic, twin-screw, sea-going, torpedo-boats of 138 tons displacement with a speed of 24½ knots maintained for two hours. The Congressional appropriation allows $450,000 for the three boats. Two classes of bids were permitted, one adhering strictly to the plans and specifications of the Navy Department, and another covering designs by the bidders fulfilling the conditions imposed. All proposals will be referred to a board of bureau officers appointed, and contracts will probably not be awarded for a month. The lowest bid was $708 per ton, as compared with $788 per ton for the "Cushing," and $946 per ton for the "Ericsson." The detail of bids is given in our "Construction News" department.

A curved 15-in. nickel-steel Harveyized armor plate made by the Bethlehem Iron Co. was officially tested with remarkably good results at the Bethlehem proving grounds on Feb. 19. Two Carpenter 10-in. projectiles of 500 lbs. each were fired against it at a range of 250 ft. The first charge used was 161 lbs. of hexagonal powder, imparting a velocity of 1,539 ft. per second, and this test was for cracking the plate. It utterly failed to do this; the plate was penetrated for about 2 ins. and the chrome-steel shot went to pieces, welding itself to the plate,with about 3 ins. projecting in the center. The second shot was for penetration and 241 lbs. of powder were used, giving a velocity of 1,940 ft. per second. Again the plate did not show the faintest sign of a crack; the projectile penetrated about 6 ins., was welded to the plate over a diameter of 18 ins., and the bulk of it was broken into minute fragments. The members of the Naval Board present declared the test one of the most signal triumphs of armor over gun and projectile ever witnessed here or abroad. Among the interested spectators was Capt. Riazanine, of the Russian Navy, stationed at Bethlehem to inspect the manufacture of armor plate for the Russian battle-ships.

The most serious railway accident of the week was a head collision Feb. 16 near Guthrie, Okla., on the Atchison, Topeka & Santa Fe Ry. A northbound stock train had orders to take the sidetrack at Seward to let the southbound Galveston express pass, but the train ran past that place and collided with the express. One man was killed, two were fatally injuried and 18 were more or less seriously injuried. Both engines and several stock cars were smashed, while the baggage, express and mail cars were telescoped.——On Feb. 15 a southbound express train on the New York Central R. R., near Rhinecliff, N. Y., ran into the derailed rear cars of a freight train going north on the adjacent track. The engine was derailed and fell onto the ice on the river, while two express cars and seven freight cars were wrecked. One man was killed and another fatally injured.——A correspondent writes us that a freight train consisting of 13 cars of iron ore, was wrecked Feb. 16 by a broken rail near Mercer, Pa., on the Pittsburg, Shenango & Lake Erie R. R.; no lives were lost.

An electric car on the Braddock & Turtle Creek branch of the Second St. Ry., Pittsburg, Pa., became stalled on the Baltimore & Ohio R. R. crossing near Rankin station, and was struck by a train. One person was killed while endeavoring to escape from the car.

A trestle erected over the line of the Cleveland, Akron & Columbus R. R. near Akron, O., by an electric railway company was destroyed by a wrecking gang of the steam railway company during the night of Feb. 14. The trestle was built by the electric railway to avoid crossing the line of the steam road at grade. This appears to be another example of those "crossing squabbles" by which railway companies educate their employees to defy law and order, and in this case the party guilty of the destruction of property appears to be even more deserving of blame than is usually the case.

International control for the Nicaragua canal would be most acceptable to the English House of Commons, according to the opinions expressed there lately in discussing the Morgan Canal bill now before the U. S. Senate. Sir Edward Hariand asked that the British government should consider the propriety of urging upon the United States the importance of creating a British and American commission to deal with the question of the construction of this canal, and its status when built. The Secretary for the English Foreign Office replied that while it was not usual to interfere with foreign legislation, the government considered that such a canal should be under international control, and it should advance this view. In the case of the Suez Canal, international control, from an English standpoint, seems to mean British control of a canal built by France and Egypt. The United States wants no similar association of interests.

A bill is before the New Jersey legislature asking for an extension of time for the construction of the North River suspension bridge across the Hudson, at New York. The proposers of the bill say that the engineers engaged upon the detail plans have progressed so far with their work that by April 1, 1895, the company will be prepared to advertise for bids for construction. They say that the company is well assured of obtaining the necessary means, and they estimate that the bridge could be completed in four years from July 1, 1895.

A Boston elevated railway company is seeking a charter from the Massachusetts legislature under the title of the Metropolitan Elevated Railway Co. Its capital is to be not less than $15,000,000 nor more than $25,000,000. Within 60 days of the approval of the act the company promises to deposit $500,000 with the State Treasurer, to secure the construction within two years of at least five miles of road on routes approved by the Aldermen. On and after Jan. 1, 1905, the company would pay a franchise tax to the Commonwealth of not less than 1 nor more than 5% on its gross earnings. The charter would extend to other cities than Boston, with the consent of the city authorities first obtained. The Boston Common and park system is excepted from occupation by the lines.

The Chicago drainage canal, now under construction, is to cost $27,883,210,according to the latest figures submitted to the Trustees of the Chicago Sanitary District by the Joint Committee on Engineering and Finance and the estimates of Chief Engineer Randolph. The total cost of the work now under contract is set down at $18,991,078; work yet to be contracted for is estimated at $3,883,899, including controlling works, bridges and channel through Joliet; the right of way cost $2,000,000, and the administration, including office expenses and rent, surveys, superintendence, printing, legal expenses, etc., for the seven years including 1890, are set down at $1,888,288. Under the existing law the most that can be obtained towards meeting this ultimate cost is $18,797,315; as a consequence a bill has been introduced into the Illinois legislature permitting the trustees to raise the tax on the assessed value of taxable property in the sanitary district, for a period of three years, from 0.5% to 1.5%. This latter and larger tax is to be levied for the years, 1895, 1896 and 1897.

The Fort Pond free port bill now before Congress is to authorize the Long Island R. R. Co. and others to acquire lands bordering upon the waters constituting the free port, and to establish piers, warehouses, etc. The port would be treated by the custom house as a bonded warehouse, all goods being regarded as in bond, so that foreign freight could be transferred from one vessel to another without special bonding. The Long Island R. R. owns a tract of land in the vicinity and is extending its line for Bridgehampton. Fort Pond Bay is on the eastern end of Long Island, six miles from Montauk Point and 125 miles from New York. It has an area of about one square mile and is well sheltered.

A company is being organized in Cleveland, O., to run a line of steel barges between that city and New York. The boats would be of the ordinary canal-boat model, with a curved "whaleback" deck, and of such shallow draft as to pass through the Erie Canal. These boats would be operated in fleets of five, with a steamer for towing each fleet. The company claims that these boats will be more buoyant than wooden canal boats, and thus have an increased freight capacity, and they would save the cost of transfer at Buffalo over present practice. Mr. John Marron, of Farasey & Marron, Cleveland, is one of the men said to be actively interested.

A 48-in. two-ring brick intercepting sewer about 11,000 ft. in length is being built at Des Moines, Ia. About 1,000 ft. of the sewer will be in tunnel through shale, sandstone and coal seams. The depth of the tunnel in places is from 50 to 60 ft. below the surface. At each lateral junction a storm-water overflow will lead to the Des Moines River, which the new sewer parallels, and into which the sewage is finally discharged. The grade of the sewer is 0.66 ft. per 100 ft. Messrs. Thos. Kavanagh and John M. O'Connell are the contractors, and Mr. Frank Pelton, City Engineer, is the engineer in charge of the work.

The cost of a Pacific cable from Vancouver to Honolulu, including three years' maintenance, is estimated at $10,000,000 by Mr. Sandford Fleming, the Canadian Government Director of Telegraphs. The offers received by the government cover a number of routes and ranges, for construction only, from about $5,340,000 to $7,585,000, the latter covering cables to New Zealand and to Australia.

Compressed air seems to be holding its own as a means of operating mining machinery, notwithstanding the broad claims made for electricity. The firm of Beadling Bros., of Pittsburg, Pa., is erecting a large compressed-air plant at its mines at Beadling, Pa. The plant is being built by the Ingersoll-Sergeant Drill Co., of New York, and comprises a straight-line class A air-compressor, with steam cylinder 22 × 24 ins. and air cylinder 22¼ × 24 ins. The machine running at 99 revolutions will deliver 999 cu. ft. of free air per minute, at a pressure of 69 to 80 lbs. per sq. in. This is sufficient to run 10 coal-cutting machines. Another large compressed-air mine plant installed by the same company 18 months ago is at Nottingham No. 15 colliery, Wilkesbarre, Pa., and consists of a pair of duplex high-pressure Ingersoll-Sergeant compressors, with Corliss valve gear, and cylinders 28 × 48 ins. on the steam end and 34¼ × 48 ins. on the air end. These compressors furnish 11,000 cu. ft. of free air per minute at 50 lbs. pressure, and supply power to four pumping and two hoisting stations located 5,000 to 11,000 ft. from the compressors. Mr. Elmer H. Lawall is the General Superintendent of this plant.

THE VAN BUREN STREET ROLLING LIFT BRIDGE, CHICAGO.

By Warren R. Roberts, City Bridge Engineer, Chicago.

(With Inset.)

A novel type of drawbridge has recently been opened for traffic across the south branch of the Chicago River at Van Buren St., in Chicago. The peculiar motion of the bridge in operation has given it the name of "rolling lift" bridge; each half of the bridge rolling backward and upward upon a segmental girder at its base. The reasons for the adoption of this peculiar design were as follows: The old bridge at this site was a swing bridge, which divided the river into two narrow channels, neither of which was in direct line with the channel above or below the bridge. A new swing bridge, even if of longer span, would not have materially improved these channels. Moreover, the Metropolitan Elevated Ry. wished to cross the river at a point near this bridge, which would not have been possible if the old bridge had been replaced with a swing bridge of longer span. The lift bridge moving in a vertical plane would permit the elevated railway to cross the river as desired; and having no center pier, a straight channel could be maintained at this point.

Fig. 1 gives a side elevation of the east half of the bridge and a longitudinal section of the west half. In this view the bridge is shown closed, ready for traffic, the dotted lines indicating the position of the bridge when fully opened. The west approach is longer than the east; the abutment and pier on the west being separated by 40 ft., while on the east they are combined in one piece of masonry. This space between the abutment and pier on the west side is bridged over with plate girders, and forms a room for the machinery. On the east side of the river, space for the machinery was provided by building a room in the abutment. In each room are placed the motors, air-pumps, air reservoirs, and other machinery necessary to operate one-half of the bridge, and each half is operated independently of the other.

Substructure.—The foundation for each part of the substructure is formed of piling, driven about 3 ft. c. to c. The piles used were about 50 ft. long, and they were driven nearly to the water, and sawed off 17 ft. below the water line. In building the masonry for the west abutment, the west pier, and the pier portion of the east abutment, open caissons were used. The bottoms of the caissons consisted of four courses of 12 × 12-in. pine, and the side walls of a single course of the same. Each caisson was built at the dock and filled with concrete until it sank almost to the level of the piling. It was then floated into position, and the concrete continued up to within 2 ft. of the water line. The pier was then faced up with Bedford stone masonry to the coping, the concrete backing for each course being put in before the following course of masonry was added. The coping was of large blocks of Bedford stone. In each pier were formed three pockets, each adapted to receive one of the tail girders of the movable portion of the bridge when revolved into the vertical position. One of these pockets is shown in the section of the west pier. Directly upon the masonry of each pier were placed three very heavy castings, each of which formed the bearing for one segmental girder. These castings are provided with teeth which mesh into corresponding holes on the steel rolling surface of the segment and prevent any slip.

Fig. 9 shows several views of the heavy steel castings which rest upon the pier and upon which the curved base of the rocking girder rolls. This casting is provided with projections like coarse teeth, which engage with corresponding holes in the curved base of the girder. The figure shows one casting only of the three which are placed together end to end to form a track for the rolling girder. Except for slight variation in the size of the teeth, the castings which carry the side girders are like those which carry the center girder. These castings are planed all over and the sides and ends of the projections or teeth are accurately dressed.

The curved member of the girder which rolls on these castings is a 3-in. thick steel plate, bolted to the flanges of the girder, as shown in the cross-section in Fig. 5.

Superstructure.—In Fig. 2 is given a half-plan of the bridge. The sidewalks on the approach join those of the movable portion of the bridge at A A, while the junction between the same parts on the roadways is at B B. When the bridge is raised, the floor of the movable part of the roadways passes back and beneath that on the approach, making it necessary to bring the latter to a very thin edge to form a connection when the bridge is closed. This connection was made for the full width of the roadways, with the castings as shown in Fig. 3. The movement at the sidewalks is the reverse of the above, that is, the moving sidewalk passes above the fixed part as the bridge is raised. The castings for this connection are shown in Fig. 4, which castings it will be seen are the reverse of those for the roadways.

Fig. 5 shows the method of applying the power to the bridge. From the machinery runs an operating strut C, joined to the center truss by a pin connection. Within this strut is a rack which engages with the rack wheel. In the position in which the strut is shown, the bridge is closed. The dotted lines indicate the position of the pin connection to the truss when the bridge is open. At the time the strut is in the first position, the latch at D, beneath the tail girder, and the pin latch at the center of the span shown in Fig. 6, are both in the position shown, and the bridge is locked ready for traffic. The first movement of the strut backward is to revolve the cam crank at E, which operates on a series of levers and shafts, withdrawing the pin latches. At the same time the small wheel F strikes the cam of the rack wheel, and the first movement of this latter wheel operating through the small wheel and the connecting levers is to withdraw the latch from the tail girders. These two duties performed, the bridge is free to move and the succeeding motion of the operating strut begins to move the bridge. In closing, these movements are simply reversed and the bridge is again locked.

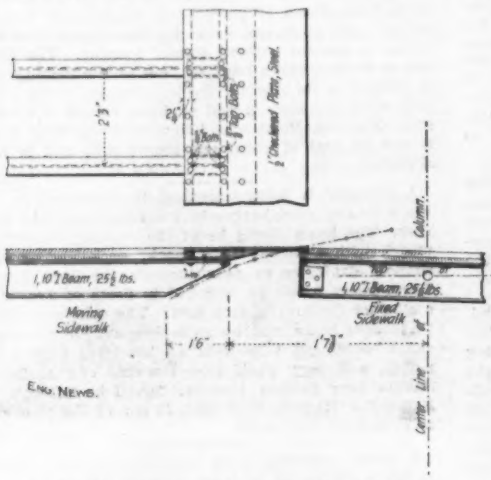

Fig. 4. Castings at Junction of Fixed and Moving Sidewalks.

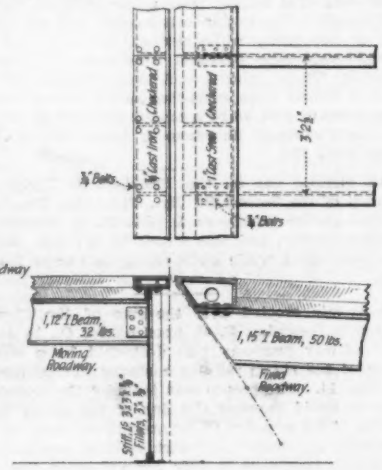

Fig. 3. Castings at Junction of Fixed and Moving Roadways.

There is only one set of machinery and one operating strut for each half span, these being connected to the center truss. As previously stated, the lock at the center is only to prevent lateral movement. The arm from E to the center acts as a cantilever, the tail girder being the anchor. These tail girders are held down by heavy anchor rods reaching to the bottom of the masonry. The bridge from E to the approach acts as a simple span, being supported at the approach by the tail girder hangers.

In raising the bridge, the power from the operating strut is carried from the center truss to the two outside trusses by heavy vertical bracing between the posts at E. Within the tail girders and between them, beneath the roadway floor, are placed the weights for counterbalancing the bridge. These weights are sufficient to prevent the bridge from coming to a horizontal position when freely lowered by the brakes. The bridge when so lowered comes to a rest a little above the horizontal; the current is then applied and the motors force the bridge down to a level.

Motors and Machinery.—The machinery and motors are shown in Fig. 7. There are two 50-HP. electric motors on each side of the river, hung on the same shaft and wired to operate in unison or separately. On each end of the motor shaft is an automatic brake wheel. The brakes on these wheels are operated by compressed air, the air compressor being operated by an eccentric on the end of the motor shaft. If at any time during the motion of the bridge, the current is cut off, these brakes are automatically applied. In addition to these brakes, there is an emergency brake on the center of the first shaft back of the motor shaft, which may be set at any time by opening an air valve leading from the air reservoir to this brake cylinder. This brake is intended to be used only in case of an accident. The bridge gates on the right-hand roadway at each end of the bridge, and the signals at the center of the span are also operated by compressed air. The air for use on both sides of the river is compressed on the west side; that to be used on the east side being piped across beneath the river and stored in a reservoir.

Of the machinery shown in Fig. 7 the gear wheels are all of cast steel, excepting the arms and hub of the rack wheel, which are of cast iron, as are also the journal boxes. On top of the center girder on each approach is located the operator's house. To each of these houses run all electric cables and all air pipes for controlling one-half of the bridge, and the operator has here before him all the apparatus for the complete control of one-half of the bridge.

Construction and Cost.—The bridge was designed and patented by the late William Scherzer, who died after the drawings for it were completed, but before actual construction had been put under way.

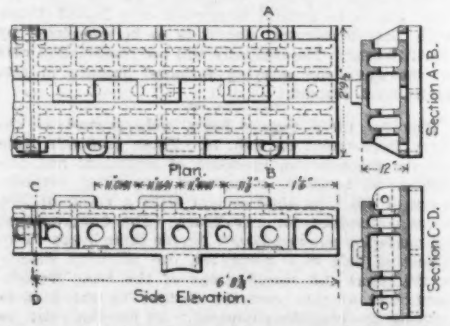

Fig. 9. Details of Bed Plates on which Girders Roll.

Work was begun on this bridge early in 1894, and the bridge was opened for traffic Feb. 4, 1895. The superstructure was built by the Fitz-Simons & Connell Co., of Chicago. The east pier and abutment, which came between two seven-story buildings, and the excavation for which was considerably below the foundations of these buildings, were especially

difficult of construction. This work was all done very successfully and with credit to the contractors. The contract for the superstructure was originally let to A. Gottlieb & Co., but Mr. Gottlieb's death very soon afterward made it necessary to re-let this work, and it was awarded to Mr. Chas. L. Strobel, of Chicago. Mr. Strobel had the iron work manufactured by the Elmira Bridge Co., of Elmira, N. Y., and the machinery by the Scaife Foundry & Machine Co., of Pittsburg. The electric equipment, including the brakes, air compressors, gates, signals, etc., was furnished by G. P. Nichols & Bro., of Chicago. The bridge was constructed under the supervision of Mr. Samuel G. Artingstall, City Engineer, and the author of this paper had direct charge of the work. The total cost of the bridge, including the approaches, the electric equipment and cables to the power house, was $169,700.

MATERIALS FOR HYDRAULIC CONCRETE AND BEST METHODS OF MIXING.*

By C. H. Platt, C. E.

While much has been written on the subject of hydraulic concrete and its uses, but little information concerning its failures has been advanced. The causes of failure in concrete work should not only be more fully considered, but such precautions should be taken in making specifications for it that all possibility of failure shall be avoided. In many instances the failures are the result of faulty or incomplete specifications, and, therefore, cannot always be directly charged to the contractor.

Having the proper materials and their exact proportions, they remain to be mechanically intermingled, and a compound formed the quality of which depends upon the thoroughness of their manipulation. The mixing, as it is generally practised, is necessarily inefficient in the thorough admixture of the ingredients and the character of the work suffers in consequence. The proper quantity of water to be used and its uniform distribution through the mass is an all-important matter, to which sufficient attention has not been given.

In works constructed under the writer's supervision three standard sizes of sea-washed silica were used, which screened as follows:

The largest size from 2 ins. to ½ in. The intermediate size, from ¼ in. to No. 14 screen. The smallest size from No. 10 screen to No. 50 screen.

In the largest size the volume of voids was 37% of the mass. In the intermediate size the volume of voids was 37% of the mass. In the smallest size the volume of voids was 36% of the mass.

If in 1 cu ft. of largest size silica 0.37 cu. ft. of the intermediate size is incorporated by measure, the volume is not increased, and it will require only 0.18 cu. ft. of water to fill the voids.

If 0.18 cu. ft. of smallest size silica is incorporated in the above, only 0.1 cu. ft. of cement will be required to complete the mixture and unite the silica.

The three sizes of silica and cement were mixed in proportions of 1 part cement, 2 parts smallest size, 4 parts intermediate size and 8 parts largest size.

In order to secure a thorough and uniform mixing, and have the cement and water uniformly distributed throughout the mass, the following method of manipulation was used: The cement and smallest size silica sand (being dry) were mixed dry; the intermediate and largest sizes were then mixed together and saturated with water, so that all their surfaces were thoroughly wetted, the surplus water being allowed to drain off.

The dry mixture of cement and smallest size silica was then uniformly spread over the wet silica and thoroughly mixed with it. The water thus provided was not only uniformly distributed throughout the mass, but was in all instances sufficient to meet the chemical requirements and cause each particle of silica to be coated with a film of cement. The mixture was then deposited in place in layers and tamped until the silica was compacted into intimate contact.

In mixing the ingredients the common error of piling the mixture in heaps was avoided, each shovelful being turned over in the place from which it was taken.

These proportions of silica and cement, mixed and manipulated as above, under the writer's direction, were used in cable railway construction on Lexington Ave., New York city. The first pulley vault south of the south line of 56th St. was constructed on May 25, 1894, and contained about 4½ cu. yds. in place, in which only 3½ bbls. of cement were used. After removing the centers, on May 28, the concrete was sufficiently hard to carry the iron work and complete the structure. An examination of this concrete will prove it to be equal to any of the concrete used on other parts of the work, where they used 1 part same brand of cement, 3 parts sand and 5 parts broken limestone.

In the cable railway construction on 53d St. the third pulley vault east of the east line of Broadway was constructed under the writer's direction, in which the same proportions of silica were mixed with Portland cement, under the same method of manipulation. The work proved highly satisfactory as compared with any of the concrete made of the 1 cement, 3 sand and 5 broken limestone mixture, in which double the quantity of cement was used.

My first experience in the use of the above described silica for concrete was in the construction of the New York tower of the Brooklyn Bridge. This silica was also exclusively used in the foundations of both towers, about 8,000 tons being used in the New York caisson alone. The load carried by each square foot of the foundation was over 7 tons. It was completed in 1872, and there was no appreciable settlement.

The following tests were made of specimens in which the different proportions of sea-washed silica were mixed with Portland cement. The tests were made after the specimens had hardened 30 days in air.

The beams tested were 4½ ft. between supports.

1. Tests made of specimens mixed in proportions of 1 cement, 2 smallest, 4 intermediate and 8 largest size silica, resulted as follows:

6-in. cubes, crushing strength 1,652 lbs. per sq. in.
6-in. cubes, crushing strength 1,618 lbs. per sq. in.
8-in. beams, ultimate transverse strength 1,839 lbs.
8-in. " " " " 1,780 "

2. Tests of specimens mixed in proportions of 1 cement, 2 smallest and 6½ largest size silica (voids filled), resulted as follows:

6-in. cubes, crushing strength, 2,697 lbs. per sq. in.
6-in. " " " 2,536 " " "
8-in. beams, ultimate transverse strength, 2,000 lbs.
8-in. " " " " 1,760 "

3. Tests of specimens mixed in proportions of 1 cement, 3 smallest size and 5 largest size silica, resulted as follows:

6-in. cubes, crushing strength, 1,240 lbs. per sq. in.
6-in. " " " 1,152 " " "
8-in. beams, ultimate transverse strength, 1,810 lbs.
8-in. " " " " 1,730 "

4. Tests of specimens mixed in proportions of 1 cement, 2 smallest and 5 largest size silica, resulted as follows:

6-in. cubes, crushing strength, 2,369 lbs. per sq. in.
6-in. " " " 2,309 " " "
8-in. beams, ultimate transverse strength, 2,250 lbs.
8-in. " " " " 2,000 "

Analyses of Silica Used.

	Per cent.	Per cent.	Per cent.
Silica	94.73	98.07	96.39
Oxide of iron	1.38	1.11	2.19
Alumina	2.80	0.82	1.42
Lime	0.59	Trace	Trace
Magnesia	0.17	Trace	Trace
Phosphorus	0.04	None	None
Sulphur	0.29	None	None

This silica was from below the water line on the north shore of Long Island. It was sea-washed and water-screened into various standard sizes, that were always uniform. At the same time it was freed of all mica, loam, and vegetable matter. Having been subjected to the chemical action of salt water for an indefinite period, all pyrites and other deleterious substances had been eliminated.

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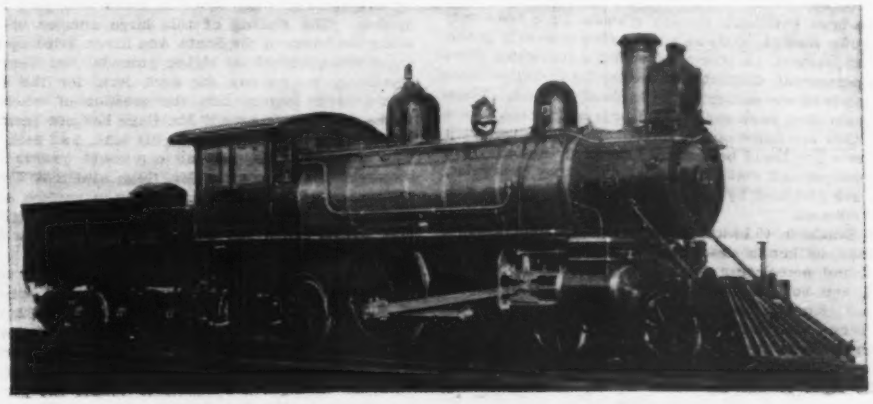
LOCOMOTIVE FOR FAST PASSENGER SERVICE; ATLANTIC COAST LINE.

A new type of passenger engine built for the Atlantic Coast Line by the Baldwin Locomotive Works has a novel arrangement of wheelbase and driving gear, as shown in the accompanying cut, made from a photograph for which we are indebted to Mr. J. R. Kenly, General Manager, Atlantic Coast Line. The engine has a four-wheel leading truck, four driving wheels, and a pair of trailing wheels, the arrangement being practically similar to that of the engine of the Chicago, Milwaukee & St. Paul Ry. illustrated in our issues of June 15 and Nov. 9, 1893. Another novelty is in making the rear driving wheels the main drivers, as in the engines of the elevated railways (Eng. News, Feb. 15, 1894) and the double-end express engines of the Philadelphia & Reading R. R. (Eng. News, June 15, 1893), but while in both these latter engines the cylinders are placed close to the front driving wheels, in the



FAST PASSENGER LOCOMOTIVE; ATLANTIC COAST LINE.

Atlantic Coast Line engine the cylinders are further forward, between the truck wheels, as in the ordinary arrangement, so that a longer connecting rod is needed, as in a mogul or ten-wheel engine, the front drivers being closer to the cylinders than in an ordinary eight-wheel engine. The engine has a swing-center truck and all the wheels have flanged tires. The valve gear is of the shifting link type, with short eccentric rods; an extension rod passing over the front axle connects the link block with the rocker, the rocker being in front of the main driving wheels. The gage of track is 4 ft. 9 ins. The leading dimensions of the engine are as follows:

Running Gear.—
Driving wheels, diam. ..... 6 ft. 0 ins.
Truck " " ..... 3 " 0 "
Trailing " " ..... 3 " 6 "
Tender " " ..... 2 " 9 "
Engine truck ..... Swing center
Journals, driving axles ..... 8 × 10 ins.
" truck " ..... 5 × 10 "
" trailing " ..... 6½ × 10 "
" tender " ..... 4¼ × 8 "
Wheel base.—
Driving ..... 6 ft. 3 ins.
Trailing ..... 12 " 6 "
Total engine ..... 23 " 10 "
Weight in Working Order.—
On driving wheels ..... 78,000 lbs.
Engine, total ..... 125,000 "
Cylinders ..... 19 × 24 ins.
Boiler.—
Diam. of barrel inside ..... 5 ft.
Firebox.—
Type ..... Radial stayed
Length inside ..... 7 ft. 5⅝ ins.
Width inside ..... 3 " 6 "
Depth at front ..... 5 " 7⅛ "
Depth at back ..... 5 " 5⅞ "
Water space, width ..... 3 and 4 ins.
Tubes.—
Number 278
Diameter ..... 2 ins.
Length between tube plates ..... 14 ft. 3 ins.
Heating Surface.—
Tubes ..... 1,913.7 sq. ft.
Firebox ..... 133.5 " "
Total ..... 2,047.2 " "
Miscellaneous.—
Capacity of tank ..... 3,600 gallons

THE DEVELOPMENT OF PERCOLATING UNDERGROUND WATERS.

The development of underflow waters has attracted much attention in the West during the past few years. It has been found that the ground adjacent to certain streams which almost or quite dry up in the summer is saturated with water which can be tapped and brought to the surface under proper conditions. Some interesting developments of this character have already been made, and others of considerable magnitude are now projected. Perhaps the most notable project now under way is that of the Spilman Suburban Water Co., of Los Angeles, Cal. Mr. L. M. Holt, well known in irrigation circles, is secretary of the company, and recently read a paper before the Farmers' Institute, of Redlands, Cal., on "Percolating Waters." This paper outlined the legal status of the subject, as understood by Mr. Holt, described some underflow developments, and outlined the plans of the above company. Mr. Holt has kindly sent us a copy of the paper, and also of the preliminary report of the company's engineer, Mr. Geo. Manuel. This report, besides containing a study of the company's project, describes a number of works carried out for the development of underground supplies by trenches and other means. We give below extracts from Mr. Holt's paper and from Mr. Manuel's report, taking up the paper first, as follows:

The laws governing flowing streams have been very carefully studied, and, as a rule, they are very generally understood. A stream of water is one which flows in a permanent, distinct, and well-defined channel from the lands of one owner to the lands of another. These channels must have well-defined beds and banks. As a rule, they are found on the surface, but sometimes such channels are found beneath the surface. But they are well defined and well known, and when they thus exist, they are governed by the same laws which govern surface streams.

In Southern California there are no underground streams, as herein described. Large bodies of water are found percolating through large bodies of gravel, sand, and boulders, buf they have no distinct underground channels, with well-defined beds and banks, and hence such waters are not governed by the laws which apply to surface streams.

The ownership of a tract of land does not carry with it the right to use the water in the stream flowing across such land. With the percolating waters it is different. The owner of a tract of land absolutely owns all the ingredients in that land, including soil, gravel, boulders, minerals, and water. If, instead of sinking a well, he drives a tunnel in his land, and secures water, that water is his absolute property, even if it flows from the well or the tunnel.

Two men, A and B, own tracts of land adjoining each other. A sinks a well on his land, and gets a flow of water. B sinks a well on his land, which is on a lower level, and also gets a flow of water. When B's well flows, A's well ceases to flow. The man who gets the water is the most fortunate. The man who loses it has no remedy and no water, and the courts will give him no redress as against his neighbor.

Take a canyon stream of water, for instance. The canyon has been filled up many feet deep with sand, gravel, and boulders, brought down by the floods, which periodically sweep down the mountain sides during heavy storms. On the surface of this debris there is a perpetual flowing stream. Below the surface there is a vast body of water percolating through the coarse formation. Following up the canyon, one occasionally passes through narrow gorges, where the bedrock appears to come nearer to the surface than at other places, and where the sides of the canyons come nearer together. At such points, as a rule, the surface stream is larger than at points above or below, because the percolating waters are forced to the surface and help to swell the surface stream. At the mouth of the canyon, the valley broadens out, the bedrock sinks to a greater depth below the surface, and gradually the surface stream disappears, and a dry wash through the valley is all that is left to mark the course of the stream, except in time of flood, when temporarily the mad waters rush down, carrying everything before them, and assisting in the gradual work of changing the surface of the earth.

The right to use the waters in that surface stream is acquired by the people of a neighborhood, and they are diverted from the stream and distributed in a system of canals, ditches, or other conduits. The rights thus acquired are confined to the flowing waters in the surface stream, and do not extend to the percolating waters below the beds and banks of the stream.

An individual buys the land at or near the mouth of the canyon through which such a stream flows. In order not to have others interfere with his rights, he buys the lands for a long distance up that stream. He runs a tunnel into and through the coarse, water-bearing sand, gravel, and boulders in the bed of the canyon, until he strikes bedrock, and he gathers in the tunnel all the percolating waters of the canyon. The waters thus developed and collected together are the property of the man who owns the land through which the tunnel runs. If such tunnel interferes with or diminishes the flow of the surface stream, he must turn back into the stream so much water as he has taken from it, but if the waters developed in another tunnel driven at a point further down the valley disappear, by virtue of the running of the first-named tunnel, the owner of the first-named tunnel does not have to make good such loss. If such development is at some distance from such a flowing stream, it becomes a matter of proof, and the owner of the development would probably not be called upon to make good such loss to the flowing stream.

The development of percolating waters in Southern California has been attempted only in a few localities, and that on a small scale, except by the sinking of artesian wells. All artesian wells in Southern California, and, as a rule, eleswhere, get their water supply from the percolating water of the lower levels of the land in which the wells are sunk. As a rule, the artesian wells have been used to irrigate, on a small scale, small tracts of land in close proximity to the well furnishing the water.

The Gage irrigation system, in Riverside and San Bernardino Cos., is a notable exception to this rule (see Eng. News, July 25, 1891.—Ed.). It irrigates many thousand acres of land, and nearly all its waters are supplied by a system of wells bored in lands belonging to the system. The sinking of this large number of wells along the banks of the Santa Ana River, dried up many other wells located on higher grounds; but there was absolutely no remedy for such loss, for the courts would never inquire into the question of where the water would have gone if Mr. Gage had not lassoed it. Mr. Gage found the water in his land, and took it; it was absolutely his, and no one could question that ownership in the courts. Mr. Gage also took some of the waters of the Santa Ana River, a surface stream flowing across his land, and others claiming rights in that stream called Mr. Gage into court, and his rights to such water were defined and limited.

Among the first development of percolating waters in Southern California, by means of a tunnel, was that of Judson & Brown, of Redlands, who, in 1892, ran a tunnel in the wash of the Santa Ana River, just below the mouth of the Santa Ana Canyon, where the river debouches from the mountains. In 1883 Chaffey Brothers commenced a tunnel to collect the percolating waters in the San Antonio Canyon. The tunnel was a long and expensive one, and the amount of water collected was not great, but it paid well for the expense of the development. There have been numerous smaller developments in various portions of Southern California, but none on a larger scale have been completed.

The largest development of percolating water yet attempted in this state was commenced about one year ago on the Mojave River, just west of Daggett, at a point known as the Fish Ponds. For miles above that point there is no surface water in the Mojave River, except in cases of heavy rains, or a flood resulting from the melting snows. The Southern California Improvement Co. is now building a canal to water a large tract of government and railway land located to the east of the town of Daggett. This canal towards its head is very deep, and cross-cuts the Mojave River bed at the Fish Ponds at a depth of about 20 ft. below the surface. In this cross-cut is buried a box flume, which gathers the percolating waters beneath the bed of the river. This submerged flume will be nearly 2,000 ft. in length, and will gather, it is firmly believed by engineers who have made careful estimates, several thousand inches of water that now and heretofore have been wasted in the desert sands to the northwest, in the vicinity of the sink ot the Mojave.

The largest development of the kind ever projected in the United States is about to be commenced near the City of Los Angeles, and is known as the Spilman suburban water system. A tunnel 2½ miles through the Cahuenga Hills will tap the water-bearing strata along the Los Angeles River at a depth of from 50 to 60 ft. below the bed of the river. For 2,200 ft. this tunnel will cross-cut the water-bearing strata, composed of very coarse sand, gravel, and boulders.

The surplus water from a watershed of 520 square miles of valley and mountain must find its way through this narrow pass on its way towards the sea. A careful estimate shows that this water which has a grade of about 16 ft. to the mile moves at the rate of 18 ft. per hour, and from this and other data competent engineers estimate that an amount of water equal to a flow of 15,000 ins., or 300 cu. ft. per sec., passes continually over the line of this proposed tunnel, and will be intercepted by it.

The city of Los Angeles laid claim not only to the waters of the Los Angeles River, but also to all its sources, feeders and springs and even to the percolating waters of the valley through which the river flows. Hence a suit to quiet title to the percolating waters of a certain tract of land was commenced last August, and on Nov. 13 after the presiding judge had intimated very strongly that the percolating waters of the land were the property of the man who owned the land, and that the city could not have any interest therein, a stipulated judgment was agreed to and entered which gave all the developed waters in the land in question to the owner of the land except such waters as might be found flowing into the Los Angeles River, which are the property of the city. There is no water flowing through that land into the river, as there are no subterranean streams there with well-defined beds and banks. Flowing waters do not percolate and percolating waters do not flow. The law recognizes this distinction, and it is an important one.

A few years ago we thought we had reached the limit of water development as well as a limit of knowledge regarding such developments. To-day we know that we are treading upon the threshhold of this branch of wealth-producing science, and that a profitable field of investigation is spread out before us inviting us to enter. It is safe to say that wealth awaits those who enter that field with confidence in an intelligent manner.

From Mr. Manuel's report it appears that the proposed tunnel, as it emerges from the hills at or near the northwest corner of the city of Los Angeles, will be at an elevation of 332 ft. above the sea, and that it will command a large area of land. The tunnel through the hills and to the edge of the water-bearing gravel will be entirely in easily workable sandstone. It is proposed to work from eight shafts, ranging from 40 to 125 ft. in depth.

From information furnished by Mr. Holt, outside of his paper, it appears that the company expects to sell water for irrigation, domestic use, and for power, claiming an available head of 105 ft. at the mouth of the tunnel. An idea of the work now proposed by the company is given by the estimate of its cost, as follows:

Main pipe to power house, 18,480 ft., 54-in., $3 per ft.	$55,440
Domestic main pipe below power house, 31,680 ft., 18-in., $1.25 per ft.	39,600
Domestic main laterals, 63,360 ft., 6-in., 20½ cts. per ft.	12,988
Domestic distributing pipes, 63,360 ft., 4-in., 15½ cts. per ft.	9,820
40 outlets with gates, at $20 each	800
Excavating main pipe line, at 40 cts. per ft.	7,392
Excavating domestic pipe line main, at 15 cts. per ft.	4,752
Excavating 24 miles of lateral pipe lines, 3 cts. per ft.	3,801
Tunnel	100,000
Power house, nozzle and wheel	10,000
	$244,593
Engineering and sundry expenses, 15%	35,407
Total	$280,000

In arriving at the amount of water which may be developed by the company, the engineer described other works for this purpose, as follows:

The proposed water development for your irrigation system is on a very large scale, so much so that it is hard to find precedents for such a work. A few comparisons with existing similar, but smaller works, however, may be instructive.

The first one was an excavation in the Arkansas River valley that averaged 6 ft. below the level of the water, and for each mile of excavation, 900 miner's (18 cu. ft. per sec.) ins. of water were obtained.*

On the opposite side of the river from the above is the Eureka Canal system. The canal or fountain at 6 ft. excavation below the level of the sheet water developed 750 miner's inches of water per mile of excavation. That process was abandoned and a well was excavated 500 ft. long, 20 ft. wide and 8 ft. deep, below the bed of the river. The 15-in. centrifugal pumps are used to lift the water out of the well into the canal. The report says:

We find it impossible to pump the water out of the well, whatever pumping power we may apply; and that we have therefore an inexhaustible supply in this way which only requires to be lifted up 5 ft. into our canal.

The capacity of these pumps would be from 1,500 to 2,500 miner's ins., according to the rate of speed at which they were run. This trench was about one-fifth the length of that portion of your tunnel through water-bearing strata. At this rate your tunnel would furnish five times 1,500, or 7,500 ins., if run at a depth of 8 ft. below the sheet water level only, but as it is

* For further description of the above see "Artesian and Underflow Investigation." Final Report of the Chief Engineer, Edwin S. Nettleton, to the Secretary of Agriculture, 52d Congress, 1st Session, Senate Executive Document 41, part II., p. 34.

to be 50 ft. below the level, its immense advantage can be seen at a glance.

On the South Platte, 25 miles southwest of Denver, a company has made an excavation which is 18 ft. below the water line. In 700 ft. of this excavation there was obtained nearly 700 miner's ins. of water.

This shows about ten times the amount of water obtained from an excavation 6 ft. deep. The usual estimate of the increase for the above depth would be nine times the quantity at 18 ft. that was obtained at 6 ft. Examinations show that the increase of the flow is equal to the square of the depth of the excavation.

Near Hartland, Kearney Co., Kan., is an excavation or fountain some 7,900 ft. in length, of which the following is a partial report by G. W. Potter.

The engineer says:

When we commenced this work, about Sept. 1, 1890, the river was dry. The river has a fall of 7 ft. per mile, and the underflow ditch 3 ft. per mile, is 18 ft. wide on the bottom, and approached the river within 100 ft. of the north bank, where it continues parallel with it. At 2,000 ft. from beginning, we struck water in a sand stratum, at 4,000 ft. 248 miner's ins. were developed and well dug at right angles with line of ditch showed that the drainage area was not over 700 ft. wide. At 6,000 ft. 500 miner's ins. were developed. At 6,800 ft. the ditch is 3 ft. deep in the water-bearing strata and 5¼ ft. below the bottom of the river, and wells dug as before show the drainage area to be about 1,500 ft. in width. At 7,900 ft. 1,045 miner's ins. were developed.

This stream has been constantly running for a year. At highest stage of water in the river, when it was from 7 to 9 ft. higher than the water in the ditch for a period of two months, and for 1,000 ft. running within 100 ft. of the river, the ditch increased in flow about one-third, which shows that the water is substantially obtained from the underflow.

Similar works are now in course of construction at Ogallalla, Neb., also on the South Fork of the Republican River above St. Francis, Kan., also near Limon, Colo. T. W. Lawrence & Co., of Denver, employ the same method to re-enforce a water-storage system, as does also the Amazon Canal Co., in Kearney, Finney, and Scott Cos., Kan.

In the tunnel run by the Grapeland Irrigation District to tap the underflow of Lytle Creek, the bottom of the tunnel penetrates the gravel at a depth of about 25 ft. below the surface of the ground, but only about 5 ft. below the surface of permanent sheet water. This tunnel was furnishing at the time of my visit last May (1894) 157 ins. of water for 145 ft. of that portion of the tunnel running through the water-bearing strata, or at the rate of over one inch to the foot of tunnel. At this rate you would get over 2,200 ins. of water at a depth of 5 ft., ten times that amount at a depth of 50 ft.

A system of development somewhat similar to the above has been successful at a point about one mile northwest of your proposed headworks. An excavation has been made by the Los Angeles City Water Co., known as Crystal Springs, to a maximum depth of 9 ft. below the level of the sheet water. In 2,200 feet of this excavation 600 miner's ins. were developed. The system has been in operation some four years and the supply has been practically the same at all seasons of the year.

In the excavation loose-jointed, vitrified pipe was laid to collect the water and carry it to the gate house, from which point a tunnel and 45-in. pipe convey the water to a reservoir in the city, where it is delivered to the consumers for domestic use.

To show the effect of lowering the head of water in a sand or gravel strata by pumping or by developing tunnels, I may mention the following taken from Southern California experience:

East Riverside wells, whose natural flow was 5 ins. each when lowered by pumping to 12 ft. below the surface, furnished 50 ins., and when still further drawn down to 23 ft. below the surface, furnished 140 ins.

South Riverside wells, whose natural flow was 10 ins. each, flowed 80 ins. each after being lowered 12 ft.

To further show the large amounts of water which are sometimes furnished by the gravel strata, I will give an instance near San Jose, in this state. Two wells situated a few feet apart furnished over 800 ins. of water when lowered 11 ft. by a centrifugal pump. The test was continued, so I was informed, for ten days and nights without sensibly affecting the water level in the wells. The gravel strata in this case aggregated 54 ft. in thickness.

In the "Scientific American" of May 18, 1889, the statement is made that there is a well on R. D. Stephens' place, near Mayhew Station, in the vicinity of Sacramento, which was 32 ins. in diameter and 120 ft. deep. This well furnished 33,000,000 gallons of water per day, or over 2,500 ins. continuous flow when pumped by a 60-HP. engine and a large centrifugal pump.

We see that in the developments before mentioned about 750 miner's ins. per mile were obtained in an open cut of average depth of 6 ft., and that 700 miner's ins. were obtained in a distance of 700 ft. where the excavation was 18 ft. deep, and with the Los Angeles City Water Co.'s development, 600 ins. were obtained in a distance of 2,200 ft., with a maximum depth of 9 ft.

The location of the last-mentioned development is in the low bottom land of the river and entirely in sand, no gravel strata being found, the result being that the percolation through the sand is very slow.

The borings made by you on your tract, and also above you, show gravel and boulders at about 30 ft. below the surface, on the west side of the valley, and on the east side the boulders extend above the water level. Your tunnel would have a pressure of 50 ft. of water, and there can be question as to a permanent water supply, and the amount will certainly greatly exceed that obtained by the open excavations or other developments mentioned above. The tunnel would cross-cut the percolating waters, and would therefore gather more water than it would if it ran up and down the valley with the flow. As your tunnel would be cut entire across the valley from the rock on the one side to the rock on the other, it would gather all the percolating water passing through the narrows above the bottom line of the tunnel.

Following the rule that the increase of the water is equal to the square of the depth of the excavation, your tunnel being not only somewhat longer than the City Water Co.'s development at Crystal Springs, but five times deeper in the water-bearing strata, would yield 25 times as much water, or 15,000 inches.

In August, 1891, the Los Angeles City Water Co. caused four measurements to be made of the volume of water flowing in the river. They state:

The upper measurement was made at a point where the river enters the Los Feliz Rancho. The next was made 200 ft. above the upper end of the Crystal Springs Water Co.'s bleeding ditches. The third was made below the inlet tower of the water company, and the fourth near the lower boundary of the Los Feliz Rancho. At the lowest point of measurement, it was found that the flow was 8,664,000 gallons per day, or 668 miner's inches, more than at any of the points measured above.

The above shows conclusively that the City Water Co.'s developed supply was obtained from the underflow, and that also the surface flow of the water in the river was increased by nearly 700 ins. from the underflow.

From careful experiments conducted in Europe, and also by the United States government officers in charge of the artesian surveys, the amount of water obtained in a cubic foot of different soils was found to be as follows:

Fine sand, 2 gallons; coarse sand, 2.5 gallons; fine gravel, 3 gallons; small stones, the size of hen's eggs, 3.6 gallons. As a cubic foot contains 7.5 American gallons, it will be seen that beds of very large gravel contain fully one-half water.

As to the quantity of subsurface water which it is possible to develop in such underground percolation, it is impossible to arrive at more than an aproximation.

As a result of experiments which have been made to determine the rate of percolations through sands and gravels lying on grades similar to those in the Los Angeles Valley, I have deduced a mean velocity of about 18 ft. per hour for this situation. This agrees somewhat closely with some experiments tried in the locality, which gave a velocity of 21 ft. per hour. As the borings made show that the materials increase in coarseness at greater depth, the velocity of percolation would also increase.

Assuming a cross-section, as shown on the profile hereto annexed, to be 4,400 ft. at the top of the permanent sheet-water level, and 2,200 ft. at the bottom of the tunnel, and a depth of 50 ft., we have an area of the cross-section occupied by water-bearing gravel of 165,000 sq. ft.

The water in material of this sort is something over one-third the mass. Applying the mean velocity of 18 ft. per hour to this area, we should have as a result 275 cu. ft. of water per second, or 13,750 ins. under a 4-in. pressure, as a probable amount of underflow to be developed.

Again let us consider the amount of water obtainable by a study of the rainfall. As stated before, the area of the watershed above the point of your development is 520 sq. miles, 180 sq. miles of which is sloping valley land. The rainfall at Los Angeles is 18 ins., and in the mountains, which have an elevation of from 5,000 to 7,000 ft. above sea level, the average annual rainfall is from 30 to 50 ins. It is safe to state that the average annual rainfall for the entire watershed is not less than 24 ins., and probably 30 ins. would be nearer the correct figure.

The rainfall over this area of 520 sq. miles would furnish water for a continuous flow of 23,000 ins. for each foot of rainfall, or 46,000 ins. for a rainfall of 24 ins. We can safely assume that one-third of this rainfall is evaporated, and that two-thirds goes into the ground, or flows off as surface water. This would leave, in round numbers, 30,000 ins. continuous flow to be carried away by the surface stream and percolating waters that flow underground through the narrow pass that connects the San Fernando Valley with the Los Angeles Plains. It is a fact that there is no rise in the Los Angeles River, except in case of exceptional floods, which occur at long intervals. During the past 50 years there have been but two such floods; one in the season of 1883-4, and the other in the season of 1889-90. Hence none of the waters of this watershed run off as storm waters, except during such exceptional floods. Allowing one-sixth of this amount (a very liberal estimate) to pass off as storm water, and we have 25,000 ins. of constant flow in the valley, only 4,000 of which is carried away by the surface stream, leaving 21,000 ins. of the percolating underground waters. Your tunnel will intercept three-fourths of the cross-section area, which would give you 5,000 ins.

MUNICIPAL ENGINEERING IN INDIANAPOLIS IN 1894.

The remarkable fall in prices for city work within the past few months and also the reduction in the cost of public undertakings which may be effected under able management, are shown by the last annual report of the city engineer of Indianapolis, Mr. Chas. C. Brown, an advance copy of which has just been received.

A large part of the report is taken up with an account of asphalt and brick paving work and investigations carried out during the year. Before bids were received for the year's work, the specifications for asphalt pavements were so changed as "to allow," in the words of Mr. Brown, "the use of Trinidad Pitch Lake asphalt, or asphalt of a quality equal in all respects or superior thereto." In May the Indiana Bermudez Asphalt Co., using asphalt from a lake in Venezuela, South America, began bidding for paving work, and after careful investigations its bids were accepted when they proved to be the lowest. Before changing the specifications, as noted above, the price of asphalt on a 6-in. concrete base was $2.85, not including the curb. Under the new specifications the latest bid was $1.94.

About half as much asphalt paving was done in 1894 as in 1893 and at one-third the cost. About 25% greater length of brick paving was put down in 1894 than in 1893, at slightly less total cost, the reduction being on account of lower prices for labor and material, there always having been free competition in Indianapolis for this work. One change in the specifications, however, admitted some new bidders, namely, allowing the use of bricks larger than $2\frac{1}{4} \times 4\frac{1}{4} \times 6\frac{1}{4}$ ins. Under this change three contracts were filled with larger brick. The streets paved with $3 \times 4 \times 9$-in. brick promise to be as acceptable and durable as any, with a probability of as smooth a street surface as is given by the smaller brick.

During the year Mr. Brown visited a number of cities to investigate the manufacture of asphalt and brick for paving. An account of these visits is given in the report.

One street was paved in 1894 with red cedar blocks on an 8-in. broken-stone foundation, and apparently will give satisfaction for some time. Mr. Brown says:

> I know of no other native wood that will make a pavement which will compare for durability with the other materials used in the city. The cost per lineal foot is almost exactly the same as for a brick street.

Sewer work was also cheaper in 1894 than previously. The work completed within the year cost $633,331. This includes work begun prior to 1894, but none begun in that year and not yet completed.

Unfortunately for Indianapolis the city exercises no control over sewer, water and gas connections after they leave the street and enter private property, nor has it any control of the plumbing work.

On the work done under the direction of the city engineer the cost of engineering, computed as in other cities, was only 1.3% of the work completed during the year. This does not include work under way, but not finished; and, on the other hand, it appears from the report that some of the engineering for part of the work was done in previous years.

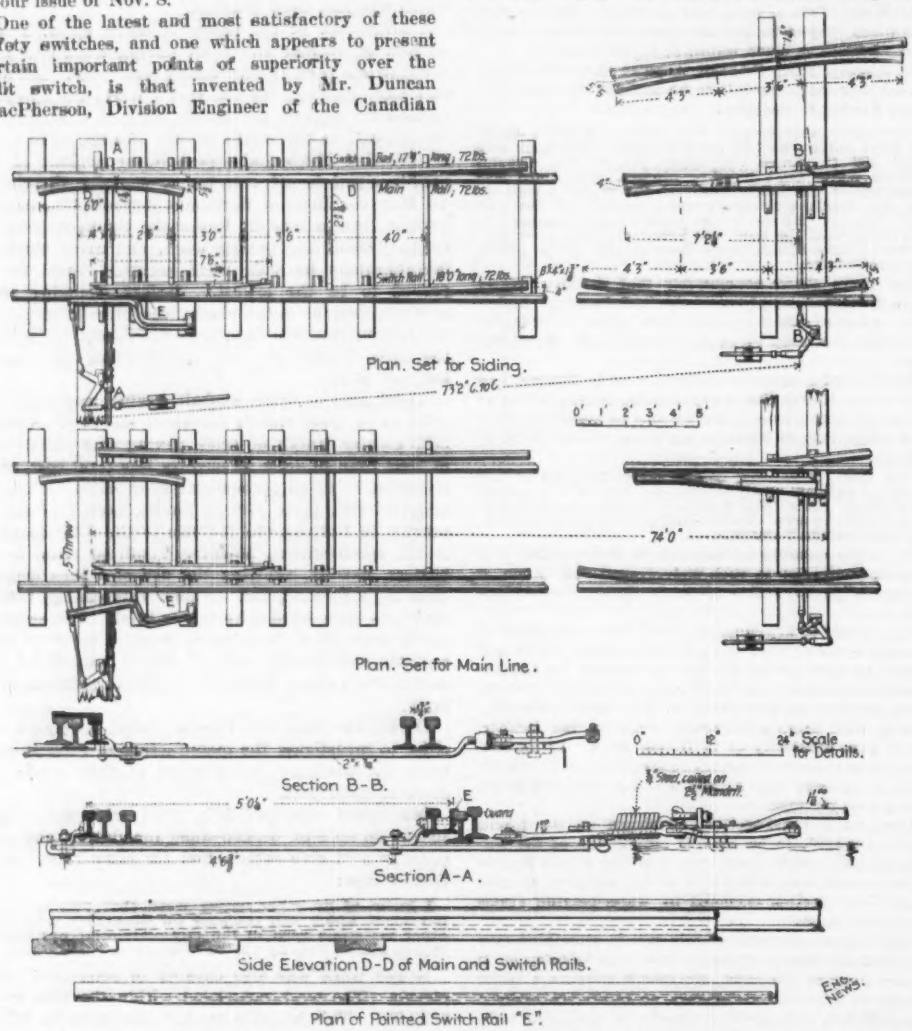
The cost of street lights, per electric arc lamps per night, is thus set down in the last report of Chief Walker, of the Electrical Bureau of Philadelphia: New York, 2,500 lamps at 40 cts., 621 lamps at 50 cts.; Chicago, 1,105 lamps from city plant, 376 at 37½ cts.; Boston, 2,296 at 35 cts.; Brooklyn, 2,200 at 40 cts.; Buffalo, 1,916 at 35 cts.; Philadelphia, 5,110 lamps at 49½ cts.

THE MACPHERSON SWITCH AND MOVABLE FROG; CANADIAN PACIFIC RY.

When the stub switch was in general use in this country various modifications were devised which were styled safety switches, and were intended to prevent derailment caused by a misplaced switch leaving the running rails discontinuous, so that the wheels would inevitably drop onto the roadbed. With the introduction and general adoption of the split switch, however, these devices became practically obsolete, and where the stub switch is now retained it is generally in the simple unprotected form, while the use of the safety spring in the switchrod or switchstand has greatly increased the efficiency of the split switch in trailing operations. In Canada, however, the stub switch is still generally used, and several safety arrangements have been introduced. On the Canadian Pacific Ry., for instance, there is used a half-Cooke switch, so arranged as to prevent derailment from the main track, as noted in our issue of Nov. 8.

One of the latest and most satisfactory of these safety switches, and one which appears to present certain important points of superiority over the split switch, is that invented by Mr. Duncan MacPherson, Division Engineer of the Canadian Pacific Ry., and tried with successful results on that road, being used in connection with a movable frog also designed by Mr. MacPherson. If set for the side track, a train on the main track may safely trail through the switch; but if set for the main track, a train coming down on the side track would be stopped at the frog. It is thought that a car blown along the side track by the wind would be more likely to be seen if stopped at the frog than if blown out along the main line for several miles. It is for this reason that the Cooke switch, used on the Canadian Pacific Ry., is made in half sets, as above noted, so as to protect the main track and to stop or derail a car moving along the side track. With the ordinary stub switch the main track and side track rails are both broken at the switch, while with the split switch one rail of the main track and one of the side track are left unbroken. With the MacPherson switch the main track rails are not broken, either at switch or frog. This is a most important feature, as the switch and frog are only touched by trains using the side track, and, therefore, other things being equal, this device should be more durable than other forms of switches.

The switch consists of two moving rails, connected by heavy switch rods, and the moving rail inside the main rail having a guard rail attached to it and also moved by the rods. A short guard rail is spiked to the ties on the inside of the other main rail. The switch rails are slightly higher than the main rails and have the ends beveled. The connection between the switch rod and the connecting rod from the switch stand is effected through a coil spring, as shown. When the switch is set for the main track the main rails are entirely unobstructed, as on any part of the open line. When set for the side track, the ends of the switch rails are in contact with the main rails, while the head of the inner switch rail overlaps that of the main rail. The switch rails, therefore, engage the wheel treads and carry the wheels up, so that the flanges clear the heads of the main rails. A main line train trailing through the switch, when thus set, will force both switch rails back, the coil spring allowing of such movement without affecting the switch stand or moving the frog.


Plan. Set for Siding.
Plan. Set for Main Line.
Section B-B.
Section A-A.
Side Elevation D-D of Main and Switch Rails.
Plan of Pointed Switch Rail "E".
Scale for Details.
Main Rail, 72 lbs.
Switch Rail, 18'0" long, 72 lbs.
73'2" C. to C.
74'0"

THE MACPHERSON SWITCH AND MOVABLE FROG; CANADIAN PACIFIC RAILWAY.

At the frog the main rail is unbroken, and when the switch is set for the main track the track is no different from that at any part of the open line. The turnout rail is raised, as already noted, and is, therefore, cut at the intersection with the main rail, connection being effected when the switch is set for the side track by means of a pivoted frog point, the toe of which rests upon the main rail. This frog point is operated by pipe connections from the switch-stand, working in conjunction with the switch, the arrangement being very similar to that of the Price movable frog, shown in our issue of April 6, 1889; but, while the latter has three hinged and movable parts, the MacPherson frog has only one moving part, which slides positively and surely into place, guided by the bar projecting under the main rail. Should a main line train trail through the frog when set for the side track, the wheel flanges would mount the incline of the beveled toe of the frog, the wheel running along the frog and down another incline upon the rail, a guard rail at the opposite main rail holding the wheels so that they cannot get on the wrong side of the main rail. The ends of these inclines are made of the right elevation to engage a wheel flange without giving it a blow. When the head of such a train reached the switch each wheel would open the switch, but without moving the frog, as the bell-crank connection from switch rod to frog rod joins the switch connecting-rod between the coiled spring and the switchstand, so that there would be no danger of derailment of the train or injury to the switch and connections by the moving of the frog point. The frog cannot move unless the switch lever is unlocked and thrown. It has been tested by trailing through it a train of 20 cars, at a speed of 20 miles an hour.

One of these switches has been in use in the Montreal yard for over a year. It was used from 25 to 50 times daily and gave entire satisfaction, the same switch being afterwards put in main line service. Another has been in use at Hochelaga for more than three years, during which time the spring in the connecting rod (which was of special design, admitting of adjustment) has not once required to be adjusted. Several other switches have been made and their service has been favorably reported upon. All parts are made of steel rails or steel forgings, and it is said that the switch and frog can be made as cheaply as the Cooke switch and frog, and will last much longer. The switch can be used with a common frog, if desired, and the frog can be used with a split switch, while the switch connections can be applied to any form of switch stand and used with or without the spring. There being no gap in the main rails, expansion and contraction do not cause any trouble, and in winter the switch has given no more trouble in snow than a stub switch. The device has been very favorably reported upon by Mr. C. W. Spencer, General Superintendent of the Eastern Division of the Canadian Pacific, and experience with it has been so favorable that several of the switches have been ordered for use on different parts of the line.

SPECIFICATIONS FOR ELECTRICAL CABLES FOR BALTIMORE SUBWAYS.

The city of Baltimore is installing a complete telegraph system for the use of its police and fire departments and including the circuits of the fire-alarm system. All the wires are being placed under ground and the work is being done under the direction of an electrical subway commission, with Mr. Nicholas S. Hill, Jr., as Chief Engineer. In our issue of Aug. 23, 1894, we published the specifications prepared by Mr. Hill for the electrical subways. The followjng are the specifications which have been prepared for the electrical equipment of the system:

Contractors shall include in their estimates all the materials and all the labor necessary for the complete electrical equipment of the underground conduit system of police and fire-alarm telegraph system as follows:

1. Lead-covered bunched cables, of the sizes and styles set forth in the schedules at the back of these specifications.

2. House terminal boxes as hereinafter specified, and placing them in engine-houses, etc., as directed by the Engineer of the Subway Commission.

3. Pole terminal boxes, as hereinafter specified, and placing them as directed by the Engineer of the Subway Commission.

4. Cable terminal and test-board for the central station, together with the necessary labor for erecting and placing the same.

5. Drawing the cables in the conduits of the police and fire-alarm telegraph system, and making all the necessary joints and splices in manholes and distribution boxes of the above system, and drawing cables up to and ready for connection with fire-alarm and police patrol boxes. Drawing-in wires will be placed in all ducts by the Subway Commission.

6. Drawing cables into engine houses, police stations and other buildings, to which distribution is made, as prescribed by the Engineer of the Subway Commis-

ac and connecting the same with the house terminal boxes above mentioned, or as directed by the Engine of the Subway Commission.

7. Drawing cables up to and connecting them with pole terminal boxes at points specified by the Engineer of the Subway Commission.

8. Drawing cables into the central station at the City Hall, and connecting them with the terminals and test-board, together with the necessary labor for placing said cables in the City Hall.

No bids will be considered unless submitted on accompanying schedule.

Samples to be Furnished.—Samples of cables which contractor proposes to furnish under these specifications must accompany proposals, the same to be plainly marked with the name, diameter of cable, size of conductor or conductors, thickness and kind of insulation, weight of lead per foot, electro-static capacity and insulation resistance per mile of conductor, and neatly fastened to boards, which may be hung. All cables furnished must correspond in every particular as to form, quality, and workmanship with samples. Samples of the lightning-arresters, terminal heads and test-boards hereinafter specified to be placed in the terminal boxes must be submitted with bids, which shall be retained in the office of the Engineer of the Subway Commission, and all like apparatus subsequently furnished must be of the same finish and construction.

Drawings to be Submitted.—Contractors must furnish detailed drawings of house and pole terminal boxes, showing the arrangement of the apparatus in the same; also detailed drawings of the test-board and terminal for the central station.

Cables.—The conductors shall be of copper of not less than 97% conductivity, and of No. 14 and No. 18 B. S. G., as specified in the schedules at the back of these specifications. Cables containing conductors of No. 18 B. S. G. gage are to be twisted in pairs, and must have a capacity not to exceed 0.15 micro-farad per mile. Cables containing conductors of No. 14 B. S. G. shall have a capacity not to exceed 0.23 micro-farad per mile. All cables shall have an insulation resistance of not less than 800 megohms per mile when shipped, and not less than 400 megohms per mile when laid, spliced, and connected up into terminals. The factory test for insulating resistance to be made with 100 volts potential, and after the cable has been immersed in water for not less than 24 consecutive hours, and after one minute's electrification. All cables shall be covered with a lead sheathing alloyed with 3% of tin. The thickness of the lead sheathing shall be on bunched cables of eight conductors or over, ⅛ in., and on bunched cables of less than eight conductors, 3-32 in. All cables shall be guaranteed in every particular (except against mechanical injury).

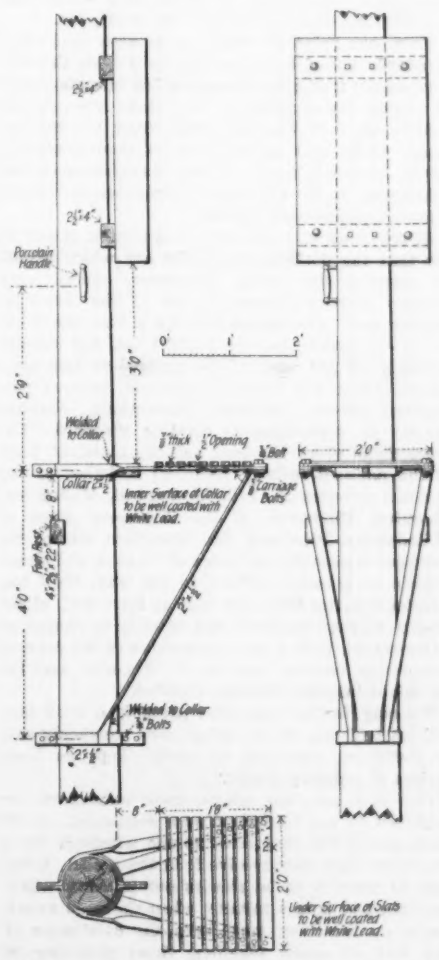
Splices and Joints.—Splices and joints must be made with the utmost care, and only experienced and expert workmen will be allowed to perform this part of the work. Contractors must file with the Engineer of the Subway Commission letters testamentary to the experience and ability of the splicers employed.

Pole Terminal Boxes.—Pole terminal boxes shall be constructed of prime quality Georgia pine, free from all imperfections, and must be water-tight. The timber must be ⅞ in. thick, and treated inside and outside with two coats of H. W. John's asbestos liquid paint. All joints shall be securely nailed with wire nails of the proper size. Contractors may specify boxes of a size to accommodate the cable terminal head, lightning arresters, fuses, etc., which they propose to furnish. Boxes shall have a capacity to accommodate 4, 6, 10, 14, 16, and 22 conductors, and the different sizes shall be placed as directed. There shall be of each size ten 4-conductor, one 6-conductor, seven 10-conductor, three 14-conductor, one 16-conductor, two 22-conductor. The door of each box must be provided with two brass hinges, and with a brass lock of strong and durable pattern, with duplicate keys. All locks must be of a standard pattern. Boxes must be fastened to poles, as shown on the accompanying drawing.

Each box must be equipped with an approved form of terminal head, lightning arresters, and safety-fuses (2 ampere). Lightning-arresters, thumb head screws, etc., must be placed on ebonite ½ in. thick, or else on slate, and ¼ in. air space must be preserved between the back of the pole box and the fixture board. Safety-fuses must be insulated from each other so as to prevent the blowing of one fuse disabling the adjacent circuits. Space must be provided for labelling the circuits so they may be readily identified. The ground connection from the lightning arrester shall be made with No. 0 copper wire, B. & S. G.; shall be direct, and shall be placed inside of ½-in. galvanized iron pipe for 15 ft. above the sidewalk. The ground plates shall be made of copper 20 × 30 ins., ⅛ in. thick, and shall be bedded at a depth sufficient to secure a good and permanent ground. The ground wires shall be securely soldered to the ground plate. Each pole upon which terminal boxes are placed shall be protected with a lightning rod made of No. 0 B. & S. G. copper wire, carried 2 ft. above the top of the pole, which shall be connected with the ground wire by wrapped joint and securely soldered. The lightning rod and ground wire shall be carried on porcelain insulators, but no kinks or bends must be made in fastening them to the insulators. Each pole upon which terminal boxes are placed shall have a platform as shown on the accompanying drawing. At all poles where overhead connections are made the contractor must furnish suitable and sufficient guy wires to stay the poles.

House Terminal Boxes.—House terminal boxes shall be placed at engine-houses, police stations, and such other points as may be directed by the Engineer of the Subway Commission. They shall be constructed of oak. Contractors may specify boxes of a size to accommodate the cable terminal, lightning-arresters, safety-fuses, and testing-board they propose to furnish. Boxes shall have a capacity to accommodate 10, 30, 50, 60, and 80 conductors, and the different sizes shall be placed as directed. There shall be of each size four 10-conductor, three 30-conductor, two 50-conductor, three 60-conductor, one 80-conductor.

The doors of each box must be provided with brass hinges and with a brass lock of the same pattern as that furnished for the pole boxes, and supplied with duplicate keys. The boxes must be securely fastened to the wall as directed. Each box must be equipped with an approved form of cable terminal, lightning-arresters, safety-fuses (2 ampere) and test-board of convenient form. The cable terminal, lightning-arresters and safety-fuses shall be in a separate compartment from the test-board. The test-board shall be removable, and so designed that it will not be necessary to change any connections for testing purposes. Safety-fuses must be so separated from each other as to prevent the blowing of one fuse disabling the adjacent circuits. Space must be provided for labelling the circuits both at the cable terminal and on the test-board so that they may be readily identified.



Platform for Pole Terminals and Method of Fastening Terminal Boxes, Baltimore Electrical Subway System.

The ground connection from the arresters shall be such as will meet the approval of the Engineer of the Subway Commission, and, where necessary, ground plates as specified for the pole terminal arresters must be furnished.

Cable Terminal and Test-Board at Central Station.—The cable terminal and test-board at the Central Station shall fulfill in all respects the specifications for test-boards, etc., specified for house terminal boxes. The terminal and test-board shall have a capacity for 200 conductors. The terminal shall be provided with lightning-arresters, safety-fuses, etc., of approved form. The test-board shall be neatly mounted, of the best construction, and so constructed as to be easy of access both front and back.

The Subway Commission reserve the right to separate of the contracts for the materials and labor herein specified, if it is in their judgment to the best interests of the City of Baltimore to do so.

The agreement accompanying these specifications further provides that all work done shall be under the direction of the Engineer of the Commission and inspectors appointed by him. Such inspectors have "authority to examine all materials and work at any time or in any manner they may deem proper," and to stop work or reject materials, subject to the Engineer's approval. Such inspectors are also to have access at all times to the factories and mills where the materials contracted for are manufactured. Further provisions are as follows:

The contractor agrees that all cables shall be guaranteed in every particular (except against mechanical injury) for three years from date of acceptance. In case the cables fail to give good and efficient service for the time of guarantee, and to show an insulation efficiency of 200 megohms per mile, at the end of three years, when tested at 100 volts potential, and after one minute's electrification, the contractor shall, on notice, furnish, within 60 days, a like amount of cable, under the same guarantee and subject to the same conditions as set forth in this agreement, without cost or expense to the city of Baltimore, or refund the moneys paid for the same, as shall be determined by.....; and the contractor agrees further to file a bond of .....to insure prompt repairs or payment of damages as aforesaid with the Subway Commissioners, the said bond to have indorsement satisfactory to the Subway Commissioners.

The contractor agrees that he will employ only competent, faithful and skillful men to do the work; and whenever the Engineer of the Subway Commission shall inform him, in writing, that any man on the work is, in his opinion, incompetent or unfaithful, he will discharge him from the work and will not again employ him on it.

In case the contractor shall fail to fully and entirely, and in conformity to the provisions and conditions of this agreement, perform and complete the said work, and each and every part and appurtenance thereof, within the time hereinbefore limited for such performance and completion, or within such further time as the said Commissioners may allow for such performance and completion, the said contractor shall and will pay to the said Subway Commissioners the sum of twenty ($20) dollars for each and every day that he, the said contractor, shall be in default; which said sum of twenty ($20) dollars per day is hereby agreed upon, fixed and determined by the parties hereto as the liquidated damages that the Subway Commissioners will suffer by reason of such default, and not by way of penalty. And the said Subway Commissioners may and shall deduct and retain said sum out of any moneys that may be due or become due under this agreement.

The contractor agrees during the performance of the work to place proper guards around all manhole openings to prevent accident, and to indemnify and save harmless the Subway Commission from any and all damages and costs which he may sustain or to which he may be put by reason of injury to the person or property of another resulting from negligence or carelessness in the performance of the work or by or in consequence of any negligence in guarding the same, or by or on account of any act or omission of the contractor or his agents; and the contractor further agrees that the whole or so much of the moneys due to him for any work he may perform under the terms of this agreement as shall or may be considered necessary by the Subway Commissioners, shall or may be retained by the Subway Commissioners until all claims and suits for damages as aforesaid shall have been settled and evidence to that effect furnished to the satisfaction of the Subway Commissioners.

It is hereby expressly agreed and understood by and between the parties hereto that the said contractor shall and will at all times indemnify and save harmless the said Subway Commissioners against any and all loss or damages, cost or expenses arising out of any claim or suit for infringement of any patent or patents affecting any articles furnished under this contract.

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The signal triumph of an American-made armor plate over gun and projectile of the latest and most powerful types, noted in this issue, is especially gratifying in view of the recent success of the Bethlehem Iron Co in competing with the foremost European and English makers of armor for the plates to be used in the new Russian battleships. It is not so long ago that well-meaning, but doubting American legislators were insisting that our government should purchase its ships for the "new navy" and the armor to protect them, from foreign makers who had learned by long and costly experience the arts of manufacture; and dire failure was predicted of any attempts at home production. Fortunately, wiser counsel prevailed; plants were created for the construction of ships and armor in a remarkably short time, and the warships now afloat, designed by Americans and built in our shipyards, are models for construction to the shipbuilders of Europe. And in the matter of armored protection, the American nickel-steel Harveyized plates have shown a record of endurance against cracking and penetration not equaled by the best armor of the older European makers; in fact, this later type of armor is now approved and adopted by them. Now we have a prominent American armor-making firm winning the contract for the plates of Russian battle-ships against the active competition of all Europe, and winning solely on the superior merits of the plates made in one of the several newly-created American gun and armor-making plants. The test of last Tuesday was a conclusive one; in the character of the gun, in the projectile used and in the enormous velocity and impact of the shot. It was, as the Naval Board expressed it, a signal triumph of armor over gun and projectile, in a battle for endurance between these types that has been waged for the last 30 years. It is a legitimate cause for national pride that this victory was won by a plate made by an American process and in an American works.

The legislation asked by the Trustees of the Sanitary District of Chicago, in order that they may continue the construction of the Chicago Drainage Canal without the possibility of interruption from lack of money, should be carried through at the present session of the Illinois Legislature. In another column we have described briefly the conditions which have made this legislation necessary. They could not have been foreseen in all their importance when the law was passed and the district organized. Fortunately, the people of Chicago perceive this, and public sentiment, as far as it has been voiced, is in favor of continuing the work without interruption, now that it has progressed so far. There should be no two opinions about the undesirability of stopping work, even temporarily. As to the bill for increasing the tax rate, it is yet too soon to discuss it in all of its bearings. It is almost certain that its passage will be conditioned upon the embodiment of several amendments desired by the people of the Desplaines valley towns through which the discharge of the Drainage Canal flows. Some of the contemplated amendments are certain to have an important bearing upon the cost of the work, and are likely to cause trouble in securing the necessary legislation. The people of Chicago owe it to themselves to see that such legislation is not delayed to the point of failure by petty quibblings or any indifference on their part.

A correspondent writes to know what are the standard sizes for trade catalogues, and by whom were they adopted. We have several times referred to this matter editorially; but its importance warrants us in again giving it prominence. The standard sizes referred to were recommended by the Master Car Builders' Association at the convention of June. 1894, and are as follows: Postal card circulars, $3\frac{3}{4} \times 6\frac{1}{8}$ ins.; pamphlets and trade catalogues, $3\frac{1}{2} \times 6$ ins., 6×9 ins., and 9×12 ins.; specifications and letter paper, $8\frac{1}{4} \times 10\frac{3}{4}$ ins.

From one point of view it may seem that these standards are of little importance outside the railway supply trade; but there are few manufacturers of engineering supplies of any class who do not receive more or less patronage from the railway supply trade, and the influence of these standards ought, in the interest of both manufacturers and consumers, to be extended throughout the whole range of engineering supplies.

In following this standard, however, it is fair to say that the 6×9-in. size is the one which should be adopted for trade catalogues, unless very weighty reasons compel the use of the larger or smaller size. The reason for this is that the 6×9-in. size is already in very general use, and already probably 75 per cent. of the pamphlets and catalogues, which are filed by engineers, railway mechanical officers, purchasing agents, etc., conform exactly or approximately to this standard. The proceedings of all the local railway clubs, of most of the national railway technical societies, of the national societies of Civil, Mechanical, Mining and Electrical Engineers, of the Engineers' clubs of Philadelphia, Pittsburg, San Francisco, and of the principal engineering societies of Canada and Great Britain at present conform to this size, 6×9 ins. Besides this, we may note that at least 90% of the reports of city engineers and officials in charge of water-works, with a large proportion of the railway corporation reports, conform to this size, and the list might be much further extended.

We may further note that pamphlets, 6×9 ins., will conveniently fit the filing cases commonly sold by stationers, and can be readily kept on book shelves of ordinary height.

The busy men for whom trade catalogues are published do not read them as a recreation. In 99 cases out of 100 they have no use whatever for a catalogue when they receive it in the mails. What they do want is to be able to put it away where they can find it in a minute when the need arises, and to do this they must keep the catalogues of each line of goods together, those referring to steam engines in one case, machine tools in another, and so forth, each man adopting a classification suited to his particular needs. Now, if the manufacturer who proposes to publish an "odd-sized" catalogue will make an actual trial of the labor of classifying a hundred pamphlets of sizes varying all the way from a little 3×5-in. to a 16×12-in. (we select specimens at random from our shelves), and will then try assorting and filing another hundred of the standard 6×9 ins., he will then appreciate the fact that the subject is of importance to the buyer, and is bound to become of importance to the seller, as the proportion of firms observing the standard increases.

The description of the Spilman Water Company's enterprise, contained in this issue, will be interesting reading to the rapidly-increasing number of engineers dealing with underground water supplies. The question of ownership in this water is an especially important one, and one which may give rise to many legal complications. The Pacific Coast law seems to assume that, as subsoil water is not a flowing stream, in the sense that a river is flowing within well-defined banks, this water belongs to the owner of the surface soil, and he can use it without let or hindrance so long as he does not interfere with the flow in surface streams. The principle seems to be that any man can intercept and remove this water from beneath his own land, subject to the above condition of leaving surface streams in a normal condition; and that if he cuts off this underground flow from a neighbor, that neighbor has no redress in law. But the very principle of this law seems to us to rest upon the fact that this subsoil water does flow. If the water under any certain piece of land were contained in a pocket, with tight walls coinciding with the boundaries of that land, there could be no question of the ownership of the water. But with the water flowing underground in a certain direction, the case is different. Two adjoining owners have undoubtedly full right to the water beneath them; but if B cuts off the underground flow of water that would otherwise go under A's land, A has no redress because he has no ownership in this water until it comes to him. Under the same Pacific law C could cut off the flow from both A and B, if his land were so situated with reference to the underground river. While the law hardly seems just, strictly speaking, it is doubtless the most direct way out of the difficulty, owing to the impossibility of exactly defining the underground limits of the saturated bed. The statement made in the paper that the increase in flow is equal to the square of the depth of excavation for the intercepting tunnel would hardly seem to apply in all cases. As a rule the porous material is not homogeneous in its deposit, and the element of friction through the mass would have much to do with the rate of flow.

The light railway movement in England has progressed so far as to have received the official attention of the Board of Trade, as noted in our issue of Jan. 17, and the report of the committee appointed by the Board has recently been presented. This report clearly explains why light railways cannot exist in that country, under the present Acts of Parliament and the requirements of the Board of Trade. In 1864, 1868 and 1870 acts were passed seemingly intended to promote such construction; but, practically, no lines have been built under these laws, mainly because they required that the consent of all landholders affected should first be obtained, and further that no existing railways or canals should be opposed to the scheme. The committee believes that the impediments to construction may be greatly diminished, and, in a very guarded and somewhat uncertain manner, suggests that in the case of undertakings of limited scope, which are approved by the locality to be benefited, it would seem reasonable to make some concessions which would reduce the cost of such lines. Among the concessions recommended for economy's sake are the approval of light railway projects by local or county councils, as a substitute for the costly Parliamentary proceedings as now conducted; and changes in the regulations relating to construction, details of route, gage, level crossings, bridges and gates, signals, continuous brakes, speed, stations, etc. The committee would make exceptional provisions where such railways affect large municipalities, giving the city as well as the county authorities power to approve or disapprove, while in all cases there should be a majority of assents in number and value of owners of land affected, and due safeguards should be provided for the public safety. In cases of compulsory acquisitions of land, there should be power of appeal to the Board of Trade. The committee gives no opinion as to whether and upon what terms the local authorities should be empowered to contribute funds towards, or otherwise take part in, any such enterprise.

Out of the 23 members of the committee, 7

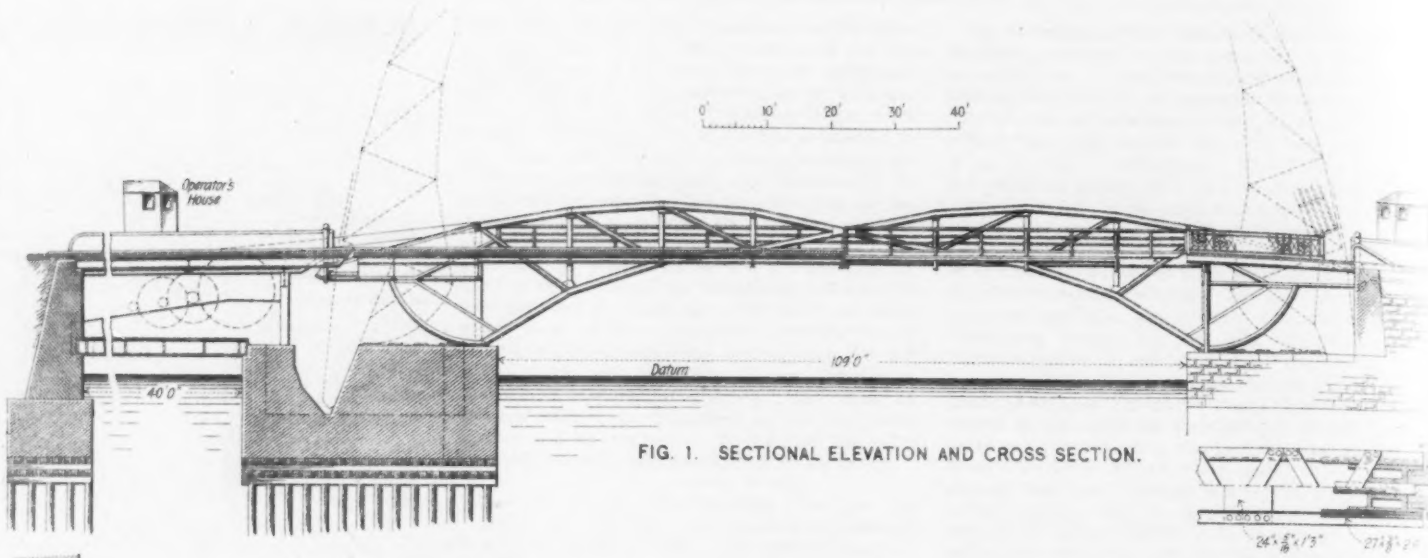


FIG. 1. SECTIONAL ELEVATION AND CROSS SECTION.

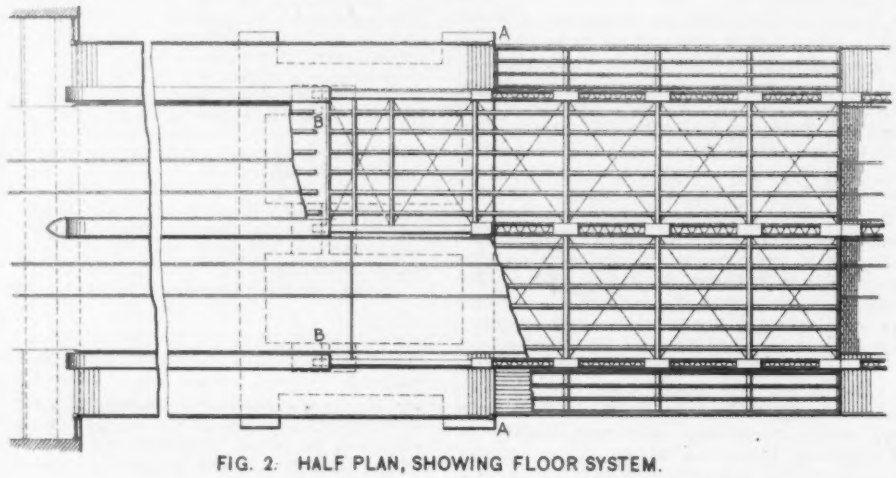
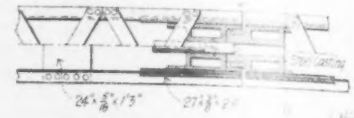
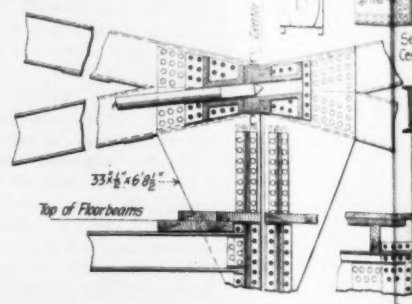


FIG. 2. HALF PLAN, SHOWING FLOOR SYSTEM.



Sectional Plan.

FIG. 6. LOCKING DEVICE AT CENTER OF BRIDGE.



Vertical Section.

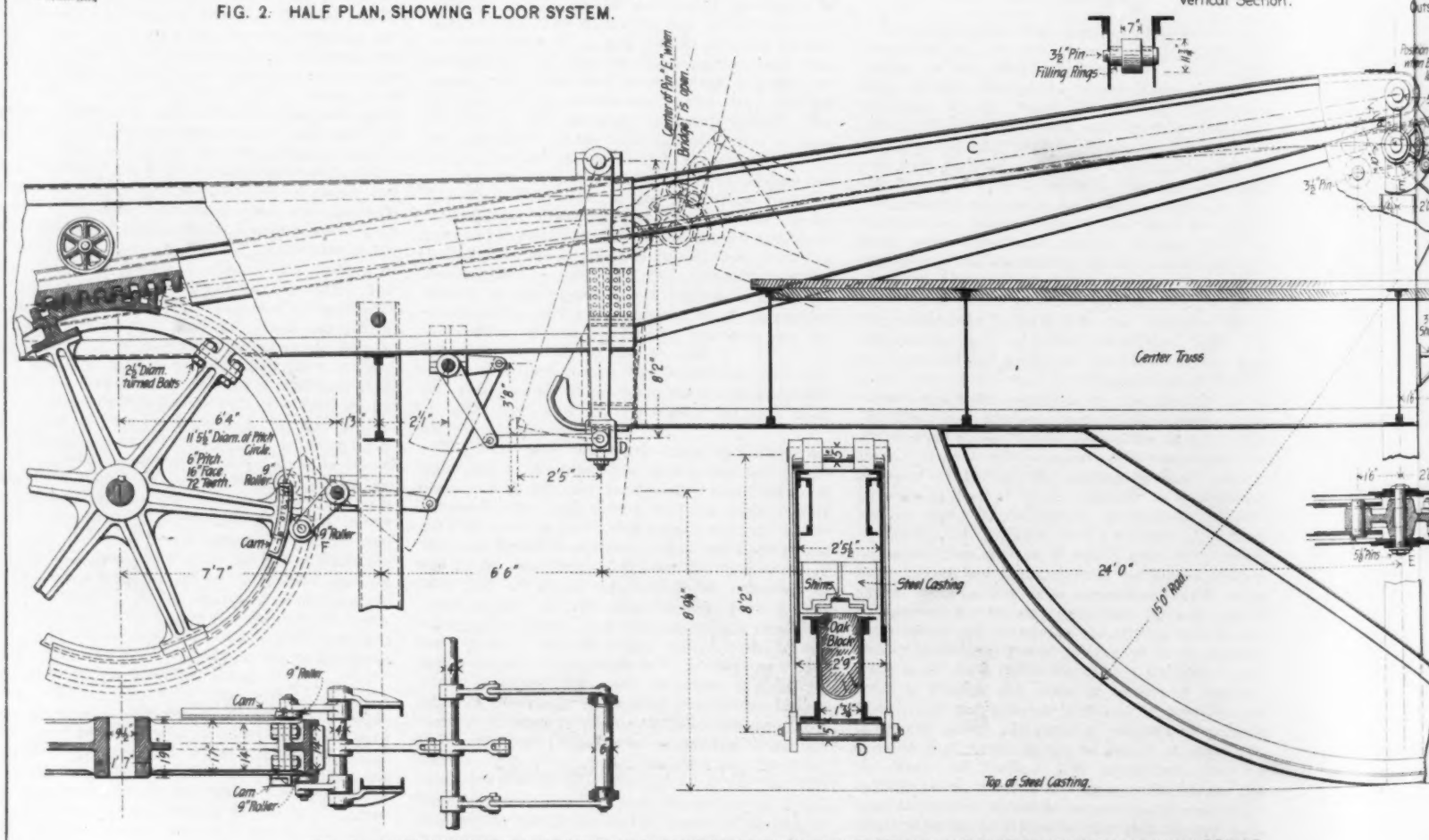
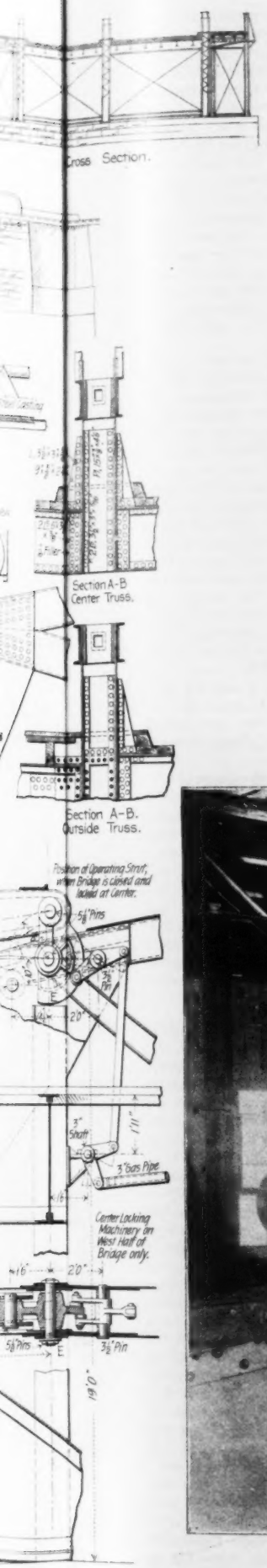


FIG. 5. MACHINERY FOR APPLYING THE POWER FOR RAISING THE BRIDGE AND OPERATING THE LOCKING DEVICE.

THE VAN BUREN ST. ROLLING LIFT BRIDGE C

Samuel G. Artingstall, M. Am. Soc. C. E., City Engi



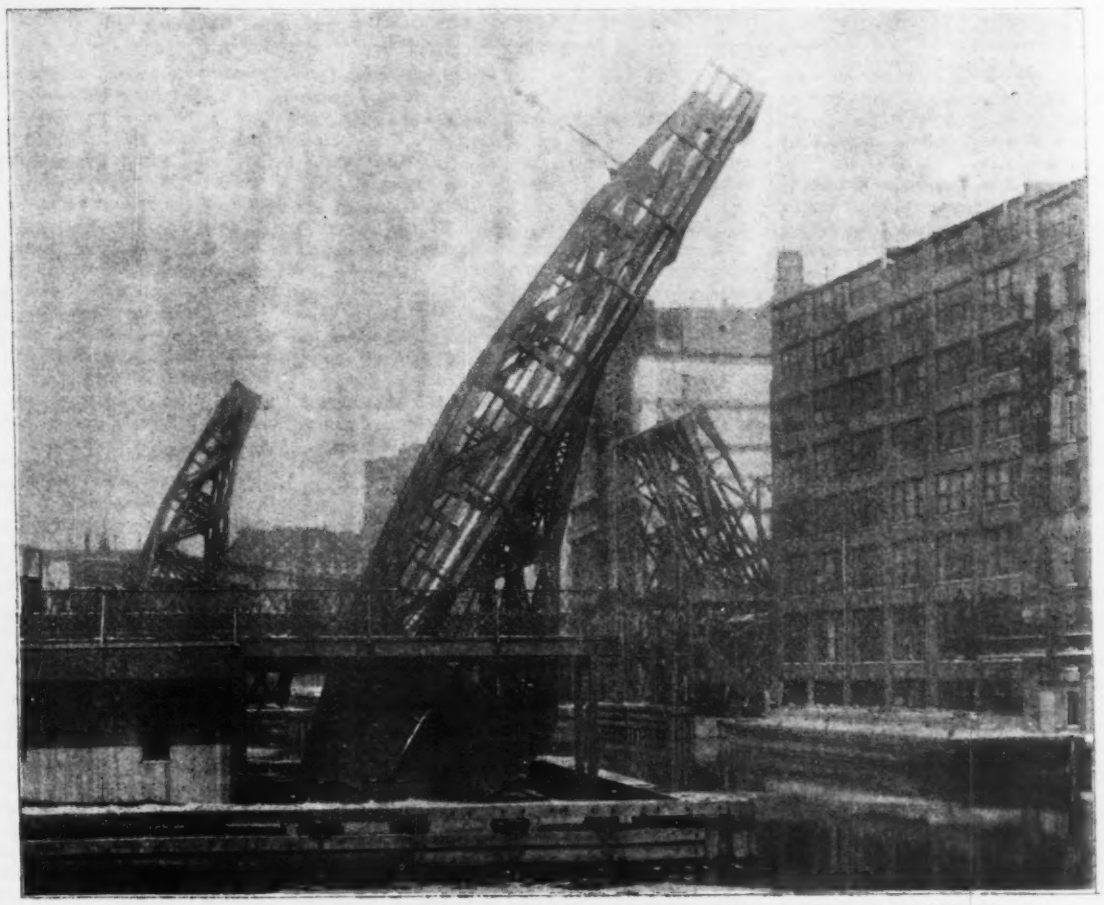


FIG. 8. VIEW OF VAN BUREN ST. BRIDGE, SHOWING METROPOLITAN ELEVATED BRIDGE BEYOND.

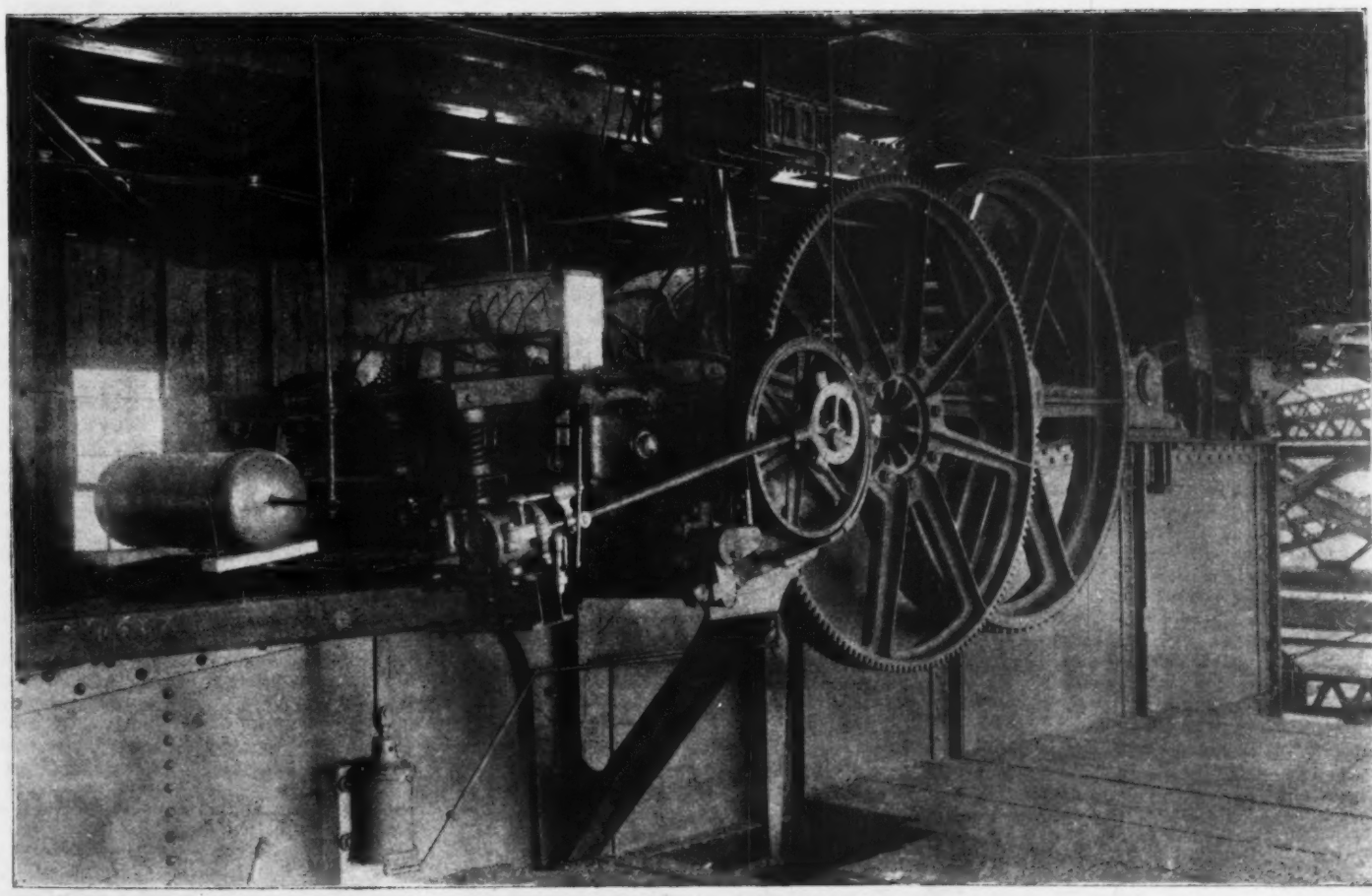


FIG. 7. VIEW OF OPERATING MACHINERY.

RIDGE OVER THE CHICAGO RIVER, CHICAGO, ILL.

City Engineer. Warren R. Roberts, City Bridge Engineer.

CHAS. HART & SONS, LITH., 33 VESEY ST., N. Y.

have objections of some kind to make to the report as issued, and append their objections and comments to the report. Some of the members fear that ordinary railways will take advantage of any concessions made on existing regulations, and build branch lines under the guise of "light railways," instead of the heavy and costly roads that present law would require in such cases. But, as the purpose of the new departure seems to be the construction of lines of transportation to points and between points where the existing traffic will not warrant too great cost, this objection does not appear to be valid, since, if the traffic would promise sufficient returns on the investment, branch lines would be built at any cost. As a matter of fact, England has already too many branch lines which are burdened by an unnecessarily expensive method of operation.

An interesting account is given elsewhere in this issue of a method of mixing concrete by which a given amount of cement is made to produce a much larger amount of concrete than is usual in ordinary practice, and without reducing its strength. It is common knowledge among engineers that the amount of cement required in concrete is only that which will certainly fill the voids. Now, by mixing materials of graduated sizes, it becomes possible to reduce the voids in a mass of aggregate to a very small per cent. of the total. To carry this idea into practice, however, it is necessary to make certain that these materials are thoroughly mixed, and that the cement is evenly distributed throughout the mass. In order to ensure this, the two larger sizes of the aggregate (let us call them broken stone and gravel) are mixed together and thoroughly wet. The cement and the smallest size aggregate, or sand, are mixed together dry and are shoveled upon the wet mass, which is then mixed with shovels. In this way each piece of broken stone and gravel is coated evenly with the cement and sand mixture and thus the cement is evenly distributed throughout the mass. By this method, we understand that a strong concrete has been made with cement forming only ⅛ to 1-14 of the total volume. In the concrete construction on the Illinois & Mississippi Canal, described in our last issue, a concrete with 1 cement to 7½ parts aggregate was used and the cement was found to constitute about 45% of the cost of the concrete. Evidently, on works where very large quantities of concrete are used, the possible reduction of the percentage of cement by the methods above outlined is a matter well worth attention.

REASONABLE RAILWAY RATES.

The rates charged for transportation of passengers and freight on railways are coming to be appreciated more and more as a factor of great importance in the growth and prosperity of nations. On the one hand, the public is certainly entitled to the lowest rate consistent with an honest and competent management of the railway property, and, on the other hand, the owners of the property are equally entitled to a reasonable return upon the capital actually invested and for the work done, provided there is traffic sufficient to pay such a revenue. The question upon which these two classes differ is as to what constitutes a reasonable rate; and of late years many attempts have been made to adjust these differences by legal enactment. In this connection it is interesting to study some of the conditions surrounding the problem, and one of the best of recent discussions is a paper in the November number of the "Annals of the American Academy of Political and Social Science." It is written by Mr. H. T. Newcomb, a member of the staff of the Interstate Commerce Commission, and is really an analysis of statistics gathered by that body.

Mr. Newcomb commences his paper with the general proposition that, unless all of the so-called evils of corporate management result in excessive transportation rates, these evils can only operate injuriously upon a limited number of individuals; on the other hand, if the rates are proved to be reasonable, the other evils complained of—and which certainly do exist—are of interest to the corporate shareholders and managers, rather than to the general public. He goes on to say that railway rates are lower in the United States than elsewhere, and they are lower here than they were five, ten or fifteen years ago; and they are quite as low as is consistent with an efficient condition of roadbed and equipment, the payment of fair wages and any return even approximately adequate upon the capital invested.

During the six years covered by the statistical reports to the Interstate Commerce Commission, the average freight rate per ton-mile has declined from 1.091 cts. to 0.878 ct., and the average passenger fare per mile from 2.349 cts. to 2.108 cts. Inconsiderable as there reductions appear, they represent, for the year ending June 30, 1893, a reduction in transportation charges of $115,113,377 on freight and $34,292,134 on passenger traffic. This is a total of $149,405,511 in one year, exceeding by nearly $50,000,000 the total of all dividends paid on railway stock and equal to 73% of the entire customs revenue of the United States during that year. It should be remembered that these reductions were made in a comparatively short period, and while they were in progress 60% of all railway stock outstanding received no dividends.

The report on railway freight rates made to the Senate Committee on Finance of the 52d Congress, by Mr. C. C. McCain, now auditor of the Interstate Commerce Commission, takes up the investigation in 1852, and it is the only one of the kind ever made. Mr. McCain summarizes his exhaustive study of the subject in these words: "From all the forms of comparison presented, it is clearly demonstrated that there has been a constant downward tendency in freight charges in all sections of the country." Mr. Newcomb points out the fact, however, that this average reduction must be considered along with the rapid development of our railway system and the immense increase in long-distance traffic, which naturally can carry freight at lower rates than is possible with a short-haul. This fact does not much affect the general comparison, however. What the reduction really is, in the period named, is little appreciated. From cases selected from Mr. McCain's report, the following results are found: The average freight rate per ton-mile, on the Pennsylvania R. R., was 5.42 cts. in 1852; 2.04 cts. in 1862; 1.46 cts. in 1872; 0.87 cts. in 1882, and 0.65 cts. in 1892. This means that 65 cts. in 1892 will pay for as much transportation on the Pennsylvania Railroad as $5.42 did forty years ago. Similar reductions have taken place in other sections of the country. In New England, the New York, New Haven & Hartford R. R. has reduced rates from 6.23 cts. in 1870 to 1.76 cts. in 1892. On the Lake Shore & Michigan Southern Ry. the average charge per ton-mile was 3.51 cts. in 1854; 2.83 cts. in 1864; 1.18 cts. in 1874; 0.65 cts. in 1884, and 0.60 cts. in 1892. The Chicago, Milwaukee & St. Paul Ry., operating more mileage than any other company in the same territory, charged 2.68 cts. in 1863; 2.49 cts. in 1872; 1.28 cts. in 1882, and 1.06 cts. in 1892. Beginning with 6.14 cts. in 1872, the Denver & Rio Grande R. R. has reduced its freight charges to 1.86 cts. in 1892; and in the same period Union Pacific Ry. reduced from an average of 2.34 cts. to 1.08 cts. When it is considered that an increase of one mill per ton-mile in the average charges for the traffic carried in one year would yield a sum equal to 90% of all dividends now paid, the importance of these reductions is better appreciated.

No single rate is of greater importance than that on grain carried on all-rail lines between Chicago and New York. The following table shows what has been done in lessening this charge in the period of 30 years:

Rates in Cents per 100 lbs.

Year.	Jan. 15.	April 15.	July 15.	Oct. 15.
1864	...	75	80	95
1869	75	50	50	50
1874	30	40	45	45
1879	35	20	22	35
1884	30	15	20	25
1889	25	25	20	25
1894	25	20	20	...

The transportation rates on anthracite and bituminous coal have been lowered from $4.05 per ton of 2,000 lbs., carried from the Clearfield region of Pennsylvania to Jersey City, to $2.25 for a ton of 2,240 lbs. in 1892. Compressed cotton bales were carried from Memphis to New York, during 1893, for a constant rate of 50½ cts. per 100 lbs., or a reduction from 74 cts. charged for the same work in 1881. Local rates have declined even more still, as from 38 cts. per 100 lbs. in 1874 to 15 cts. in 1894.

As the existence of this tendency to reduction in charges is well established, Mr. Newcomb seeks the reason for this tendency. It may be confidently asserted that, except in extremely rare cases, it is practically impossible to maintain for any considerable period railway rates which are excessive. The interests of the railways and their patrons unite in creating conditions against which it is in vain for any railway official to contend for extremely high rates. From the standpoint of the railways, an excessive rate limits the quantity of traffic, and if carried far enough the rate may become prohibitive. The expenses of railway transportaion are roughly divided into those arising from operation and the fixed charges, in the proportion of about 69% for the first and 31% for the second item. The fixed charges are entirely independent of the volume of traffic, and a considerable increase in traffic may be accompanied by a relatively small increase in operating expenses. It follows as a sequence that a large traffic at low rates is often more profitable than a smaller traffic at higher rates, a fact well appreciated by railway managers. Low rates also tend to develop a territory contiguous to the lines of a road and to promote the final and permanent prosperity of such lines.

On the part of the shippers, low rates are constantly appealed for, and the pressure thus exercised is too great for continuous successful resistance. A concession of a few cents enables the shipper to reach more distant markets, or to successfully underbid a rival in those already reached. Commercial conditions, the importunity of rival shippers, as well as the provisions of the Interstate Commerce Law, require that any concession made shall be open to all shippers of the same or similar commodities, between the same localities in the same direction. The same interstate law also requires that intermediate rates upon similar traffic shall not be in excess of those to more distant points. Concessions granted on one line at once bring pressure for similar concessions on other lines leading to a common market, and these must usually be granted under the penalty of a loss of traffic. Railways must also compete with water carriage, in a large measure, and thus the action and interaction of forces far beyond legislative restraint or the control of a single carrier unceasingly operate to reduce transportation charges, while the greater economy in operation and management enforced and made possible by lower rates and increased traffic, in turn, permits further reductions.

As far as the investor in railway properties is concerned, a careful study of the income returns for railways made to the Interstate Commerce Commission for the year ending June 30, 1893, shows the following average results: Of the aggregate income 90% is required to pay the cost of operation, including wages of employees and officers, cost of materials used, repairs of roadbed and equipment, etc.; 3% is paid to various state and municipal governments for taxes; 8% goes for rents, and 2% for miscellaneous expenses of association, etc. Thus a total of 73% of the aggregate revenue is absolutely required for expense which must precede the right of the bondholder to interest or the stockholder to dividends. Of the remaining 27%, in the year ending June 30, 1893, 18.26% went to pay interest on funded debt, 6.10% to pay dividends on common stock, 1.26% to pay dividends on preferred stock, and the remaining 1.38% to pay interest on current liabilities, and to add to the surplus account.

Mr. Newcomb shows by tables of the highest and lowest rates of interest paid that the average rate of income on all funded debt and common and preferred stock now outstanding is only 3.42%. From the same tables it appears that 61.24% of all the railway stock and 14.39% of all the bonds representing funded debt, paid neither interest nor dividends. As he says, unless it can be shown that the present capitalization of the railway system of the United States is grossly excessive, there is sufficient evidence to show that the return to investors

therein is no more than is fair or reasonable, if not far below what is just and proper.

The relation between the par value of railway capitalization and the just value of railway property, says Mr. Newcomb, is a problem of extreme difficulty, and probably does not admit of detailed solution. The difficulties surrounding it are much enhanced and its conditions obscured by the frequent confusion of just value with the amount of actual investment, or original cost. The public has no right to demand rates too low to afford a fair return upon the just value of the railway property; but, on the other hand, it is also true that no railway is entitled to interest and dividends upon the original cost of its property, without regard to how much this cost was enhanced by profligate expenditure, corrupt misappropriation of funds, or depreciation in value by changed conditions of traffic. In attempting to estimate the amount of capitalization upon which the business of transportation should afford a fair return, the following figures are given: On June 30, 1893, the total capitalization of the railways of this country was $10,506,235,410. From this should be deducted $611,610,171 of floating debt and $1,563,022,233 of stocks and bonds, owned by the railway companies. The remainder, outstanding and owned by the investors outside of the railways themselves, is $8,331,603,006 in stocks and funded debt. These latter figures are assumed to be a reasonably accurate measure of the true value of railway property, whether this value depends upon the present cost of duplication, the present and prospective earning capacity, or the price at which the properties could be purchased from present owners.

The amount of "water" in existing stocks is an unknown quantity and is variously estimated by writers on the subject. Some place it as high as three-fourths of the aggregate; others contend that its amount is entirely offset by the amount eliminated by foreclosure proceedings. As to the latter feature, it is true that from the beginning of 1876 to 1893, 551 railway corporations, operating 57,283 miles of roads, representing 3,209,126,000 in stocks and bonds, were sold under foreclosure. This tremendous insolvency, with its resultant sales under the hammer of the auctioneer, may easily have resulted in wiping out an amount of stocks and bonds little, if any, less than that created by stock-watering.

Mr. Newcomb contends that, as railway rates have been steadily declining for a considerable period and do not now produce an exorbitant return upon an approximately accurate measure of the just value of the railway system, it must be concluded that the aggregate railway revenue is at present just and proper. He also says that, under current conditions, any schedule of rates producing a lower revenue than that now received would be unanswerable and unjust to railway owners.

But, conceding reasonable rates as an average, it is quite as important that there should be no unjust discrimination against persons, places or classes of traffic. Unfortunately for the railways and for their patrons as well, competitive strife for traffic continually results in these unjust discrimination, and it has gone on throughout the whole period under study. Reasonable and just discriminations, based upon the value of the service performed, are essential and should continue; but all rates based upon favoritism or prejudice should disappear. Mr. Newcomb lays down the following general rule, making the carriers' revenue the sole criterion of charges, with the single limitations that rates must be open to all: "Charges between all points and upon all articles should be fixed at the point where, observing the reasonable limitation of total revenue, each particular rate will produce the greatest possible revenue above the absolute cost of handling. Constant endeavor to create new traffic should be made, and none should be refused which can afford to pay rates producing the smallest revenue above the cost of handling, with a reasonable allowance for the estimated depreciation of permanent way and equipment, directly attributable to that traffic." He thinks that the ultimate result of an enlightened and consistent enforcement of such a policy by a large number of important railways, or, better still, by a consolidated railway exclusively operating in a large territory, would certainly result in lower rates than any likely to come from legislative action so far attempted.

LETTERS TO THE EDITOR.

THE ILLINOIS & MISSISSIPPI CANAL—CORRECTION.

Sir: In your article on the Illinois & Mississippi Canal you give Mr. John D. Lynch credit for the work done on the fourth and fifth miles. Mr. Lynch executed the earthwork on the first three miles of canal trunk under contract; but the work on the fourth and fifth miles was done entirely by hired labor under my own direction.

The concrete mixer used was of 64 instead of 4 cu. ft. capacity. The Taintor gate shown is one of four at Mill Creek, the ones at the Guard Lock being higher. The two dams built were across the two channels at the head of the rapids.

Very respectfully yours, L. L. Wheeler.

Sterling, Ill., Feb. 16, 1895.

CORRECTION OF ERROR IN TRAUTWINE'S POCKET-BOOK.

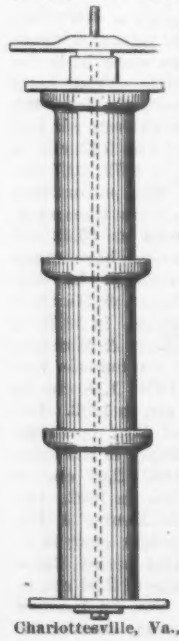
Sir: My attention has just been directed to an error in the table of lengths of circular arcs to a radius 1, on p. 145 of our "Civil Engineers 'Pocket-Book," where the length of an arc of 67° is given as 1.1093706, whereas it should be 1.1693706.

The error first appeared in the 41st thousand, 16th ed., 1892, and it seems to be due to the zeal of a superserviceable artisan, who found the type defective and proceeded to replace it with what he supposed was the proper one, omitting, however, to report the change. Yours truly, John C. Trautwine, Jr.

419 Locust St., Philadelphia, Feb. 16, 1895.

A DEVICE FOR HOLDING SEWER PIPE VERTICALLY WHILE MAKING CEMENT JOINTS.

Sir: In the Engineering News of Jan. 3, under the heading of "Tests of Tightness of Cement Joints in Vitrified Pipe Sewers," you produced a sketch of a cradle for making joints with the pipe in a vertical position. Even in the deep socket and over-filled joint would not the bond be liable to break when the pipe is removed from the cradle? The enclosed design represents three sections of pipe, held in position by an iron rod. To this rod is securely fastened, at the spigot end, a narrow piece of 1-in. oak board, extending beyond the sides of pipe. At the bell end the rod passes through a similar board, thence through a second. With ordinary threads on the rod, screw handle and a washer, the pipes are screwed down and firmly held in position. With this simple device the joints can be made and the pipe laid to one side until the cement has set. The rod may then be withdrawn for further use. When the cement has set, the rod may be replaced and screwed up firmly, and the section lowered into the trench and lined up without breaking the bond. Then unscrew the handle and withdraw the rod from the lower end.



C. E. Dickinson.

Charlottesville, Va., Jan. 21, 1895.

WADDELL'S SYSTEM OF BRIDGE LOADING.

Sir: My attention has to-day been called to the fact that certain bridge engineers have lately been checking the curves of equivalent loads for truss spans given on Sheet No. 4 of my pamphlet on "The Compromise Standard System of Live Loads for Railway Bridges and the Equivalents for Same," and that the results of their calculations do not agree with these curves. They agreed very well for short spans, but their equivalents for large spans fell below mine. The reason for this is that, in computing equivalents for chords I assumed that cars precede as well as follow the two coupled locomotives, thus covering the entire span with live load for all chord members, while they did not assume any cars ahead of the engines.

The equivalents given on my diagram are averages of the equivalents for all chord and web members of any truss, and their correctness (barring slight variations in plotting, is unquestionable, as all calculations were made by two independent computers. It was an oversight on my part in not mentioning in the preface that cars were assumed to precede as well as follow the locomotives in computing the equivalents for chords. This matter will receive attention in the second edition. Very respectfully yours,

J. A. L. Waddell.

Kansas City, Mo., Feb. 16, 1895.

EARTHWORK COMPUTATIONS.

Sir: Possibly the following may be of at least momentary interest to you:

To find the volume of a railway prismoid when the two end sections are given: To each depth of cut or fill add one-half of the corresponding depth in the other end section. Find the areas, in square feet of the new cross-sections thus obtained.* The sum of these areas, divided by 81, and multiplied by the length (in feet) of the prismoid, will give the exact volume (in cubic yards) of the prismoid indicated by the original cross-section notes.

This is only a special application of a perfectly general "prismoidal formula," which I believe to be a new one.

The following is an example: Roadbed, 18 ft. Slope, 1½ to 1.

Sta. 51	7.6 / −6.6	6.9 / −6.0	6.1 / −5.8
	18.9		17.7
Sta. 52	5.3 / −2.0	4.8 / −1.8	4.1 / −1.2
	12.0		10.8

$$\text{Vol.} = \frac{100}{162}(6.9 \times 36.6) + (4.8 \times 22.8) + (7.6 + 6.4 + 5.3 + 4.1)\,9 = 353.4 \text{ cu. yds.}$$

Very truly yours, O. V. P. Stout.

450 No. 16th St., Lincoln, Neb., Feb. 4, 1895.

THE COMPARATIVE VALUES OF COARSE AND FINE SAND FOR CEMENT MORTARS.

Sir: After looking up some of the references you gave (Eng. News, Jan. 3) in regard to the relative values of fine and coarse sand for cement mortar, it occurred to me that perhaps there is no real disagreement between their results and mine. Is it not possible that coarse sand is better than fine sand up to a certain point, and that beyond that the reverse is true, and that my experiments only dealt with the latter circumstances? Not having the necessary time to experiment on this point, I only offer this suggestion.

Yours respectfully,

A. S. Cooper, Asst. U. S. Engineer.

Savannah, Ga., Jan. 16, 1895.

(In "Annales des Ponts et Chaussees," vol. II., 1890, which was one of the references mentioned, the tests recorded were made with sands varying in the sizes of their grains from 4.67 mm. (0.18 in.) to 0.27 mm. (0.01 in.) The following table, selected from the several given in the paper, is a fair index of the results obtained:

Size of sand.	P. c. water.	Tensile strength, kilo. per sq. cm., at ages of: 3 dys.	7 dys.	28 dys.	3 mths.	1 yr.	2 yrs.
25-45	15	1.97	3.83	6.56	8.79	10.73	12.14
45-60	17	1.29	3.87	7.49	10.45	11.35	13.14
90-110	22	1.	2.50	5.24	9.27	11.11	10.36
140-175	27	0.77	2.22	4.90	6.90	8.32	11.24
175-280	33	0.39	1.94	4.17	6.74	8.21	9.06
Mixture of above five sands.	22	1.45	3.29	7.39	10.49	13.17	14.16

The figures in the first column denote the number of meshes per linear centimeter in the sieves used; thus a 25-45 sand is one which passes a sieve having 25 meshes per centimeter and is held on a sieve having 45 meshes per centimeter. The 175-280 sand is very fine, being, in fact, the "blown" sand (sable fin des dunes) of the sea coast. This sand appears to have been fully as fine as the finest sand used by our correspondent in his tests.—Ed.)

A NEW CHEMICAL FIRE EXTINGUISHER.

Sir: In a recent issue of your valuable paper you had an editorial on "Chemical Methods of Preventing and Extinguishing Fires." In the course of it you speak of the carbonic acid class of fire extinguishers, and I believe that you had in mind the well-known Babcock extinguisher and the Miller. I enclose you a circular of a machine which meets all your objections to the class. As you will see by the sectional view, the acid is kept in a small bottle, fitted with a loose lead stopper, so that the fumes of the acid cannot get out. When the machine is wanted for use, it is simply turned upside down; the stopper falls out, and the generation of gas begins at once. The rubber hose has no stopcock, so that the gas finds an immediate vent. If the machine is accidentally upset, no damage further than the throwing of a little soda can result. There are no cocks and devices to confuse a person, as in the Babcock, and anybody can handle it successfully. The thing works like a charm, as I can testify, having discharged a number myself.

Yours very truly, H. S., C. E.

(The extinguisher described appears to be in very extensive use in the West and South. Its simplic-

*Base will remain same as in original cross-sections, but side slopes will vary.

ity certainly commends it in comparison with any form of extinguisher we have seen that depends on the pressure of gas in the interior of a closed chamber to throw a stream upon the fire. On the other hand, we incline to the opinion that it is still better practice to use a neutral solution of chemicals for the extinguishing fluid and use a syringe or hand force pump to throw it upon the flames. It may be, however, that the gas-generating capacity of the fluid formed by the mixing acid and alkali is greater than that of the solution of neutral salts which we have examined. We learn that the extinguisher to which our correspondent refers is in use by the Standard Oil Co., the Pullman Palace Car Co., and in a large number of whisky distilleries. We judge from this that its efficiency in extinguishing fires is in inverse proportion to the scientific accuracy of the circular describing its operation. It is called a "Nitric Oxide Generator." But how a solution of "soda" (probably $Na_2 CO_3$) plus sulphuric acid ($H_2 SO_4$) can generate nitric oxide (NO), is a puzzler. We may note also that nitric oxide gas is not soluble in water. We conclude, therefore, that "Nitric Oxide Generator" is only adopted as a high-sounding trade name; somewhat on the same principle that one of the makers of the neutral salt solution referred to above calls it the "electric" extinguisher.—Ed.)

THE REVERSIBLE LEVEL TUBE.

Sir: In your issue of Jan. 24, there is a description of a level tube which has recently been placed on the market by Seelig & Kandler, of Chicago. This tube has two opposite openings, with a fixed scale over each, whose centers and graduations are exactly opposite. In order to construct this tube so that it will be of practical utility, it is necessary to grind the interior of the glass tube and fasten it in the holder with such extreme accuracy that the positions of the bubble above and below the telescope, when the line of collimation is level, will be exactly opposite their centers in a vertical line. To accomplish this is almost impossible. If it were possible, the cost of construction would be so great that the average engineer could not afford to use it.

I respectfully call your attention to my inclosed circular which describes a device secured to me by patent, being No. 460,909, bearing date Oct. 6, 1891. You will observe that I have overcome the difficulty or rather impossibility of perfect construction referred to above, by the use of a movable or sliding scale.

I know that the glass tube can be so accurately ground that when the bubble stands exactly in the center of the fixed scale below the telescope (the line of collimation being level) and the telescope is turned vertically through exactly 180°, it will come wholly within the opposite opening and the sliding scale can be readily adjusted to its position. I have had six of these tubes made. They are all perfect. With proper machinery, which would cost a small amount of money, my tubes can be made as easily and cheaply as the tube with one opening, now in general use.

The Seelig & Kandler tube is probably an infringement on my patent, but I do not care how many such tubes they make, as they are worthless.

Very truly yours,
J. A. Brown, Civil Engineer,

Wilmington, O., Jan. 29, 1895.

(We referred the above letter to Messrs. Seelig & Kandler, who furnished the information from which our original description was prepared, and append their reply as follows.—Ed.)

Sir: Regarding the statements made in the letter of Mr. J. A. Brown, of Wilmington, O., a proof of which you have kindly sent us, we have a few words to say. Mr. Brown questions the accuracy of the reversion level made by us, and described in your issue of Jan. 24, 1895, and implies that we are infringing upon a patent of his by manufacturing it. We see no reason to believe that Mr. Brown has a right to claim to be the inventor of the reversion level. The firm of Amsler & Laffon, of Schaffhausen, Switzerland, suggested this device as early as 1860. Exhaustive articles on reversion levels will be found in "Dingler's Polytechnisches Journal," Vol. 153, and in the "Zeitschrift der Culturingineur," published by Prof. Dunkelberg from 1868 to 1870. A similar device has also been used by Messrs. Stark & Kammerer, of Vienna, Austria. The only difference between their device and the reversion level described in your columns is that they constructed a tube with but one graduation and one opening and reversed it 180° on its axis by means of pivots at the ends. We do not claim to be the inventors of the reversion level, nor do we think that we infringe on Mr. Brown's patent by constructing it, but we do claim to have been the first makers to apply the devices to wye levels.

Mr. Brown, evidently without having seen or tested the reversion level as manufactured by us, claims that it is impossible to make such a device accurately. This indicates that he is not very well posted in the manufacture of engineers' instruments. The time has not yet come when it is impossible to improve the manufacture of such instruments. Reversion levels are furnished by us which show errors no greater than 1" to 1½" of arc. They are graduated so that 2 mm. indicate from 10" to 15" of arc. Such errors are imperceptible with any telescope used on ordinary engineering instruments. If a reversion level is properly mounted—as we mount ours—the horizontal line of sight will be perfect in both positions of the telescope. We have proved by actual practice our claim, i. e., that we can make perfect reversion levels, and we shall not discuss that matter further here.

Very truly, Seelig & Kandler.

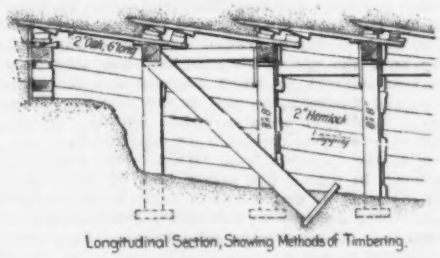
Chicago, Ill., Feb. 14, 1895.

BUILDING A SEWER TUNNEL IN QUICKSAND.

Sir: In the course of construction of the Goodman St. and State Hospital sewer at Rochester, N. Y., the contractors were obliged to drive a tunnel through a hill of quicksand about 500 ft. in length. As most of the work around Rochester has been in rock, the contractors were apparently afraid of the work. The contractor to whom the work was finally awarded went at it as well as he knew how, but at the end of a second month he found that his men had advanced only 100 ft., and that the men were becoming more afraid of the work every day, as bad cave-ins were very frequent, at times completely burying the men in the breast. The contractor thus found himself paying out double the money he would receive from the the city, and was very glad to give a sub-contract to Mr. William Jones, of Pittsburg (a man of long experience in soft-ground work), and the author.

After we had looked the ground over, we decided to erect a simple builder's derrick over the shaft and use

Cross Section of Finished Tunnel.



Longitudinal Section, Showing Methods of Timbering.

Constructing a Sewer Tunnel in Quicksand, Rochester, N. Y.

cars and flat skips. As the amount of material that would be removed from the breast in each shift was very small, the heading being 6 × 6 ft., we decided to work the derrick by hand, the muckers raising their own cars. We placed in charge of the work Mr. John Collins, of Philadelphia, a soft-ground miner of unusually varied experience. As soon as Mr. Collins had got together miners for two shifts, he examined the breast and found it in such bad condition that it took nearly a week to get in the first set of timbers. The ground being finally caught up, the miners felt more at ease and began their excavating, thinking that their trouble was over; but the next day without the least warning the breast came in with a rush, and had it not been for the unusual care taken by Mr. Collins in placing his timbers in the breast, the men would all have lost their lives. After this inflow was removed, all went well for the next 100 ft., when a bed of boulders was encountered embedded in the quicksand, and as it was impossible to think of blasting with ever so light charges in such material, it was only by the slowest progress and utmost watchfulness on the part of the men that the danger was passed. At times the quicksand was almost as hard as rock in the breast, but at the same time it would come in instantly if given the least chance.

The timbering in the breast was done with a center leg, and in some cases a false cap and raker, the completed work being tied up with stretchers. The timbers were placed about 4½ ft. c. to c., using 8 × 8-in. hemlock, with 6-ft. oak lagging 2-in. thick on top and 2-in. hemlock lagging for the sides. The lighting of the tunnel was done entirely by candles, with a gasoline torch at the top of the shaft for the night shift.

Even with the unusual precaution taken and the corresponding extra time taken in the start of each shift, the work was advanced on the average of 4½ ft. to a shift. The work was done with two miners in the breast and two muckers loading their own cars and raising them by hand to the dump. The shaft being in a low place, was but 25 ft. deep. The men usually completed their day's work, that is, as a rule, one set of timbers, in seven to eight hours. The miners were paid $2.50 per day, and muckers $2. The work of driving and timbering the tunnel complete amounted to $5 per lin. ft, that is $2 per ft. for timber, lights and tools, and $3 per ft. for labor.

Willard D. Lockwood, Jun. Am. Soc. C. E.

Rochester, N. Y., Jan. 4, 1895.

GAGING THE DISCHARGE OF THE NIAGARA RIVER.

Sir: In your issue of Dec. 27 you publish some remarks by Major E. H. Ruffner, Corps of Engineers, U. S. A., with reference to the discharge of the Niagara River. While the International Bridge was under construction across that river, the Secretary of War appointed a Board of Military Engineers to examine the site and location of piers for the bridge. It may be of interest in the discussion of the river's discharge to refer to the gaging which was then done by order of the Board.

It was in 1870, I think, that the engineers of the bridge (I was then first assistant) were directed to gage by floats along a series of eleven parallel lines, embracing the width of the river, the velocities and direction of flow of the stream at the site of the bridge. The observations were made with floats of 3 × 4-in. scantling, 12 ft. long, weighted to float nearly vertically. These were put into the river from a tug at a point about 1,800 ft. above the bridge site. Two observers at instruments, one at each end of a base line on the shore, took simultaneous half-minute observations of the floats, and recorded the angles. I see by my records that more than 150 readings were taken in this way, which, when plotted, gave the direction of flow and velocity of the stream between each two observations along each of the eleven lines observed.

From these and other carefully taken data, it was computed that the mean velocity at the bridge was 6 ft. per second, and the area being nearly 41,000 sq. ft., gave a discharge of 246,000 cu. ft. per second. I have no means at hand of applying the water level on which the computation was based to the M. L. L. of Lake Erie.

There are, of course, more exact means of gaging. With the current meters, and the aid of vertical velocity curves, as a general thing, more accurate results may be obtained; but the method described gives directly the mean velocity of the whole vertical section in which the scantling floats, and has an essential advantage in enabling the whole cross section of the river to be rapidly gaged. The fluctuations of the water level in the Niagara River are extremely variable. Our records of three years' daily observations show an extreme range between the highest and lowest water recorded of 6 ft. 6 ins., both in the month of December, but not in the same year, 4 ft. 6 ins. of this being above, and 2 ft. below, our assumed low water level. On the occasion of the latter, a northeast wind continued for many hours, and lowered the water in the river to a point below the intake pipe of the Buffalo Water-Works. The diagram prepared from these daily observations showed also that the fluctuations of the water level, day in and day out, even in summer, when light winds prevail, were very considerable. With a strong southwest wind blowing I have known the river at the bridge to rise in four hours as many feet, or more, and the center velocity to increase from 5½ to 12 miles per hour in consequence. I point this out because these abrupt fluctuations, added to local disturbances, make the determination of accurate discharge in the Niagara an extremely complicated matter, and whether it be by floats or meters, or however accurate the means employed, it is only conceivable that a rough computation can be had, never twice alike, and ever with widely varying results. The very basis of calculation of mean velocity is an imperfect hypothesis, giving higher results in large streams than small ones. I believe it quite possible that there may be found to be a difference of 100,000 cu. ft. per second between the maximum and minimum flow of the Niagara.

The declivity of the bed between the entrance of the river and the head of Grand Island is very irregular, showing varying depths between 18 and 45 ft. To this may be attributed the eccentricities of velocity and direction of flow to be met with. Our diagram indicated that the surface fluid filaments in some of the lines of gaging swing quite abruptly across other con-

tiguous lines, instead of, as might be assumed, taking courses parallel to one another.

It was observed as somewhat curious that the water rose in advance of the wind which causes it to rise; that is, before the wind coming down Lake Erie reaches its east end.

I may mention that our observations covered the full cross section of the river, and were made in a single day. Yours truly,

J. G. Macklin, M. Am. Soc. C. E.

Cardinal, Ont., Feb. 2, 1895.

THE CRACKS IN THE RESERVOIRS AT PORTLAND, ORE.

Sir: You have from time to time during the last few months made mention in your columns of the construction of the large system of water-works which has been in progress at Portland, Ore., during the past year; and in one of your recent issues you make mention of certain difficulties which are being encountered in connection with two of the four large distributing reservoirs that have been built.

As I have been watching the progress of the work with much interest, it presenting many novel features, and being of a magnitude and magnificence of finish very unusual in Western American engineering; and having recently made a personal examination of the locally-much-talked-of difficulties, the results of my observations may be of interest to yourself and readers.

I shall not attempt any elaborate description of the reservoir construction, as it has already been outlined in your columns. The high-service reservoir on the east side and the low-service reservoir on the west side, locally known as Nos. 1 and 4, are apparently in perfect condition, and are full of water. The low-service reservoir on the east side (No. 2) had been emptied after remaining full for some ten days or two weeks, by reason of a considerable settlement being observed at different places on the bottom. The reservoir is built principally in excavation, but has an embankment about 12 ft. in height on one side. It is lined with two courses of brick laid flat in paving pitch, and the whole covered with a coat of asphaltum. The excavated material consisted principally of yellow clay, largely intermingled with boulders. After about two-thirds of the bottom had been excavated to grade, it became apparent that the difficult character of the remaining materials to be excavated would necessitate the work going over to another season. To avoid this, the grade of the bottom was raised 5 ft., and the part already excavated was refilled to the new grade. Although this work was done with care to prevent after-settlement, water and ramming being freely employed, besides being carefully rolled with a heavy steam roller, a considerable inequality of settlement took place. The lining, however, generally adapted itself without injury to the new conditions, but in a few places the water penetrating the lining had caused the underlying material to flow into cavities which had escaped filling among the boulders, and caused the paving to break. The asphalt coating on the bottom was in many places raised in blisters, which I attribute to its having been put on late in the season, after the fall rains had begun, when it was impossible to get the bricks sufficiently dry to secure perfect adhesion. Thus the back pressure, when the reservoir was emptied, operated to push the asphalt up in water blisters at these points. There is nothing in the condition of the reservoir which seems to me to justify any apprehension, but the large number of embryo hydraulic experts, conceived in ignorance and malice and always hatched at the first indication of unforeseen difficulties, however trivial, in public works construction, have not been backward in making this a pretext for much slander heaped upon those responsible for the management of the work.

Reservoir No. 3 presents far more serious difficulties. It is built in a ravine in a formation of yellow clay and broken basalt intermingled. A concrete dam is built across the lower end of the reservoir, and the slopes and bottom are lined with 6 ins. of concrete, into which are built twisted iron rods, spaced 2 ft. each way. Very serious cracks have formed in the lining of the south slope and parapet wall. There are different theories held regarding the cause of the difficulty, but it seems conclusive to me that the 1½ to 1 slope used is steeper than the angle of repose of the underlying material, which contains a large percentage of slippery yellow clay in proportion to the amount of broken rock, and is always saturated from springs, and from its nature almost incapable of drainage. The remedy evidently contemplated by Mr. J. D. Schuyler, the engineer in charge of the reservoirs during construction, was to buttress this troublesome slope sufficiently to make it stable, as the adoption of a flatter slope would have seriously lessened the capacity of the reservoir. One buttress was built during the construction, to check a slight tendency to slip which developed at that time, it not being continued the whole length of the slope at that time, probably by reason of hesitancy to incur the additional expense before causes for rendering it necessary became apparent. The work itself seems to have been carefully and intelligently performed in the face of most unusual natural difficulties—difficulties of such a nature as to render the site an unfortunate one. The undertaking of the construction of these four reservoirs in one short Oregon season was a great one, and when sufficient time shall have been given for the remedying of the difficulties usually incident to great works, the public will soon come to recognize the greatness of the work which has been wrought in spite of the political influences incident to almost all public works being executed by day's labor.

Very truly yours, A. L. Adams.

Astoria, Ore., Feb. 7, 1895.

BROOKLYN CIVIL SERVICE EXAMINATION FOR THE POSITION OF ASSISTANT ENGINEER.

Sir: In your issue of Dec. 27 you published the questions which candidates desiring positions as Assistant Engineer in the State Engineer's office, and also those wishing such positions in the city of Brooklyn, would be called upon to answer; and, since it seems to me it will be of use to the young men in the profession to have some information concerning the result of the Brooklyn examination, I take the liberty of calling your attention to some points which occurred to me while looking over their papers. The number of applications was 107; number at written examination, 86; number at oral examination, 75; passed and placed upon eligible list, 46.

The thing which made the most impression upon me, and to which I would particularly like to call the attention of young engineers, was the fact that the candidates failed to fix in their minds some of the plainest and simplest elements of the questions before them. There seemed to be, on the part of a large number, a lack of power to concentrate their thoughts upon the topic before them; and, as a result of this, some of the questions were answered in a way which gave the candidates a low mark, when they could just as well have had a high one. The particular questions to which this applies most, and in which this failure will be evident, were Nos. 7, 17, and 18. In No. 7 the question was how some very elementary trianguiation should be done if a line ran east, a stream ran northwest and southeast, and all of the triangulation must be done on the north side of the line. There was a considerable number of answers in which the triangulation was sketched on the south side of the line. Comment is hardly necessary. A young man who could not fix in his mind a question without any more acuteness than was shown by those who did not know the difference between north and south, would hardly be trusted in charge of any work away from the eye of his superior. The other two questions referred to asked for sketches of catch-basins and manholes, as well as descriptions. There were a number of cases in which, although the description was given, no sketch accompanied it.

One of the questions was, "What is the maximum safe load, in pounds per square foot, to place upon good dry sand or good earth in constructing foundations?" The answers to this varied from nothing to 250,000 lbs. About 60 gave some answer. They may be classified as follows:

Under 500 lbs. per square foot	3
500 to 2,000 " " " "	4
2,000 to 5,000 " " " "	10

Some answered 4,000 to 12,000; 6,000 to 10,000; 8,000 to 12,000; 10,000 to 14,000; 12,000 to 16,000; 85,000 to 100,000; and so on up to 250,000 lbs. per square foot. One member of the Am. Soc. C. E. said 80,000 to 100,000.

Very few of the answers said that conditions as to moisture would affect the carrying power of the earth, nor did many say that the depth of the earth above the bottom of the foundations would affect the amount which could be put on a square foot. Those who gave the lowest answers evidently did not remember that an ordinary man, by standing on his heel, may put a load of 150 lbs. on 6 or 8 sq. ins., which is from 2,700 to 3,600 lbs. per sq. ft. I put the question to two of our best known engineers, and their reply was "from 0 to 6 tons, depending upon circumstances." Another, whose name is equally well known, and particularly in connection with very deep foundations, said that the allowable weight depended almost entirely upon the depth of the foundations and the natural load upon the surrounding earth. The answers of the candidates show a lack of comprehensive knowledge or a lack of thought, as was the case in many other answers.

One answer, with reference to asphalt pavement, said it "seems to kinder rot" when water stands on it. Some answers relating to pavement foundations spoke of "rolling the concrete with 15-ton steam rollers" instead of ramming it.

In reply to a question about the boiling point of water at a given elevation above the sea, one candidate said that at an elevation of 5,000 ft. above the level of the sea, "you could not boil an egg," and another, that "on the top of high mountains water will not boil." One, who was answering a question about granite block pavement, said that its cost, "with profit to the contractor, would be about 70 cts. per sq. yd." Perhaps the most remarkable sentence of any candidate was in answer to the question, "What is meant by the term 'duty' as applied to pumping engines?" He said: "A pump should, in order to fulfill its duty, have sufficient exhaustive power to produce such a vacuum as will allow the pressure of the air to cause the water to ascend to such a height as will allow it to flow from the orifice or nozzle of the pump."

If these comments upon the examination may have the effect of impressing men who try other examinations with the necessity of fixing their minds upon the questions before they undertake to answer them, and also with the fact that it is better for a man to leave a question blank, or to say that he cannot answer, than it is to try to answer and make an egregious blunder, my purpose in writing this will have been served. Yours truly, Jos. C. Platt.

Waterford, N. Y., Feb. 5, 1895.

AERATION AS A MEANS OF PURIFYING SEWAGE AND WATER.

Sir: The subject of sewage disposal and the purification of alluvial river water has been long considered and well digested by chemists, but the engineering end of the question has seemed to lag. About a year ago the subject was experimented on at St. Louis, and the result of these experiments may be given as follows:

Aeration was employed in which the liquid to be treated is absolutely disintegrated or reduced to spray. At the same instant of time and in juxtaposition with the liquid spray must be an atom of disintegrated air. What is the result? Organic matter accompanying the liquid is at once seized by the different constituents of the air, and there is produced pure water and harmless inorganic compounds. How performed? By a screen floor, say, with pepper-box perforations, over which is a layer of coarse river sand, somewhere below another layer of sand, leaving an air chamber between the two. Then, to duplicate nature, cause a rain storm of the liquid to be purified by forcing air into the chamber of a little less pressure than what is sufficient to sustain the weight of the liquid in the tank. These drops falling on the fine sand, which must be kept unsubmerged, are then and there purified. The perfect disintegration of air and liquid is mechanically performed by the sieve action of the top filament of sand. In this way from 6,000,000 to 15,000,000 gallons of liquid can be treated per acre per day. The lower air-screen is self-purifying, and can be made of any necessary depth to perform the work.

In cases of very strong sewage or very much polluted water, additional sand screens have been suspended in the air chamber, grading the sand to a finer quality from the top screen downward. This method disposes of the sludge question. Also aspirators have been attached to the perforated floor, discharging air to the surface of the primary screen, from which the excess air is returned to the chamber by the descending liquid. The aspirators were used with fine gravel. They serve to agitate the surface and prevent clogging.

In preparing sewage for treatment, it should be thoroughly aired and screened. For this a centrifugal disk screen is operated by a motor driven by the sewage. The screened liquid is collected in a depressed funnel-shaped receptacle, and the residuum is discharged into an intercepting duct surrounding the funnel, and flushed off into dump cars.

The sand in the air chamber, or for the lower bed, should be of the finest river material, unscreened. The sand for the primary screen should be uniform in size, and just coarse enough to enable it to take in such particles of sludge as cannot be eliminated by the centrifugal screen. All sludge must be digested by the primary screen, and none allowed to go into the air chamber, as the purpose there is simply to deal with the material in solution.

This final screen, or sand bed, at the bottom of the chamber serves as a vent to carry off, without shock the polluted air from the chamber, and incidentally to do just so much work as may be required to complete the purification in any given case. Its resistance must be greater than that of the primary screen. On the rate of travel through it depends the capacity of the machine, and it is the only screen that gives resistance to the ultimate flow.

The compressed air inlet pipe is carried down nearly to the lower sand bed, so that any breakage outside of the chamber will result in flooding only to the pipe

orifice, as the diving bell feature comes into play. On the other hand, any accidental excess pressure is provided for by means of a combined air-gage and vent. In cold weather the compressed air should be warm, to prevent freezing. Waste heat from a steam boiler could be used by providing a proper jacket.

Maximum pressure is obtained in a gasometer large enough to run the machine over any reasonable interval of stoppage of pumps.

It has been estimated that a plant with everything complete, except power and storage for air, floating plant and real estate, but with no auxiliary screens, would cost $55,000 an acre. Such a plant would be built substantially as follows: Granitoid bottom, resting on cinders; concrete and brick foundations; side walls 6 ft. high, composed of cast iron gratings, and the same material for supporting the primary screen plates, the latter resting on the lower flanges of I-beams; one of our best non-corroding metals for a wall lining and for the screen plates, the latter, of course, perforated; a wooden tank resting on the side walls; and finally, glass windows and metal shutters.

An estimate of the monthly expense of operating a two-acre plant in three shifts per day shows:

1 superintendent at $150	$150	
2 assistants at $100 each =	200	
9 men, expert laborers, at $50 each =	450	
		$800
Repairs, maintenance and interest, say 20% per year or 1⅔% per month on $110,000 =	1,833	
Fuel, oil and incidentals	150	
		1,933
Total monthly expense		$2,733

The minimum output of 6,000,000 gallons per acre per day would yield for the two acres 360,000,000 gallons for the month, which, on the above basis, would cost $7.45 per million gallons. With a maximum output of 15,000,000 gallons per acre, the cost per million gallons would be only $3.10. But this output would really cost more, as it could only be secured by the aid of auxiliary screens. The additional expense caused by these would be chiefly for interest on plant. In even figures the maximum output may be put at $3.50 and the minimum at $7.50 per million gallons.

In regard to the purification secured, a reference to the report of Mr. Geo. W. Fuller (Eng. News, Nov. 29, 1894) shows that, at Lawrence, he obtained a result of 95.5% of organic matter, and 99.8% of bacteria removed, using a mechanism similar to this in every way, except that he had no air in his second filter, nor did he have the auxiliary screens. Therefore, of course, his output was light—something less than one million gallons per acre per day. As he had no air, his final or controlling screen was very deep, and in some way purified. In what way is not explained. But he says, on p. 443:

> The removal of sludge by sedimentation enables filters of finer material to be operated at higher rates than filters which receive ordinary sewage. It appears that it would be advisable to employ sedimentation in many large filters, where the sewage is strong and the filters are not cultivated.

It might be proper to add that Mr. Fuller was informed of the workings of the "St. Louis" method some ten months ago.

Sand is of no value for the purification of water, except as a means to an end. Unless air is given to every grain, it soon becomes loaded with a fermenting, festering filth, and, as Mr. Fuller says, every attempt to use it for sewage, without air, has been a perfect failure, and, it may well be added, always will be.

For less polluted waters, it can be used for a time, but it can be safely said that it is not good engineering practice.

Sand filtration is nature's remedy, but nature accompanies it with aeration. Every rain drop falling on an impressionable surface, following the laws of nature, settles into that surface, pumping air downward into its voided wake, which is again filled by the succeeding drop. Consequently, the entire surface of the earth is purified by a rainstorm; not by any inherent virtue of the earth (filter) itself, but by nature's great purifier, the air, aided mechanically by water.

J. H. Curtis.

St. Louis, Mo., Dec. 27, 1894.

(The purification of water and sewage by artificial aeration is a matter on which inventors have been at work for many years, as our correspondent may see by referring to the Patent Office Reports. In our issue of Feb. 9, 1893, was given a description of elevated sewage filter beds in use for some years at Atlantic City, N. J. This system, known as the West system, has been in use on a small scale for sewage purification elsewhere, and its promoters claim that it is also applicable to the purification of water supplies, doing its work largely by aeration. At Fitchburg, Mass., an experimental sewage filter plant was built two years or more ago by Mr. Asher F. Black, of Malden, and was still being experimented with a short time ago. In this plant there is not only an upper and a lower sand bed, but before the sewage reaches the sand it is passed through special spray sieve belts, the air surrounding these belts being exhausted by fans and carried to a furnace fire. Fresh air of course rushes in to take its place. Aspirators have been attached to the sand filters at the Lawrence Experiment Station, the latest trials of them there having been described in our issue of Nov. 29, 1894. Various methods of aeration are in actual use in connection with American water-works systems, but they are generally designed to remove or prevent taste, odor, or in some cases to remove iron, from the water. Experiments made by Prof. T. M. Drown, of the Massachusetts Institute of Technology (Eng. News, Aug. 25, 1892), and those carried on under the direction of Prof. Wm. P. Mason, of the Rensselaer Polytechnic Institute, with others that might be named, have shown that simple aeration of water or of ordinary fresh sewage, will not greatly reduce its organic matter. What the intermediate aeration may do is to supply the deficiency of oxygen likely to exist in freshly-filtered water. By so doing the water might be passed on to the second bed in a better state for filtration. It is questionable whether the desired amount of additional oxygen could not be supplied just as effectually by passing the water in thin sheets over weirs, thus saving a large part of the expense of supporting elevated sand filter beds.

Mr. Curtis gives no figures to show just what he accomplished in the way of bacterial and chemical purification, merely stating that "from 6,000,000 to 15,000,000 gallons of liquid can be treated per acre per day." The minimum rate is not very high, considering the cost of constructing and operating such a plant.

Since the above comments were written, Mr. Curtis has inserted some additional matter in his letter, including that relating to cost and efficiency and to simple sand filtration, all of which increases the doubts previously expressed regarding the practical value of the scheme. In the estimate of cost of construction, land and compressed air plant are omitted and the figures lack greatly in detail. Assuming that the device experimented with will effect as great purification as that secured at Lawrence is begging the question completely. Of course, sand filters are but a means to an end, and, of course, if they contain no air they will do no work, except to serve as mechanical strainers. As has been well said, in the reports on the Lawrence work, purification depends upon bacteria, oxygen and time. Mr. Curtis seems to be trying to increase the amount of oxygen greatly at the expense of the period of time, and makes no reference to the part played by the all-important bacteria. There is not a word in his communication to show how the results, under such conditions, compare with those obtained along the lines followed so carefully for years at the Lawrence experiment station and in actual practice at many sewage and water filtration plants.

At the request of Mr. Curtis we have submitted proofs of his communication to Mr. Geo. W. Fuller, Biologist-in-Charge of the Lawrence Experiment Station of the Massachusetts State Board of Health. Mr. Fuller has made some comments on the the subject, which are given immediately below. —Ed.)

Sir: The reference by Mr. Curtis to the Reports of the Massachusetts State Board of Health on the purification of sewage by intermittent filtration, where artificial aeration is used for the removal of air in the filters, shows such a complete misapprehension of the process of purification by bacterial action, as well as misconception of the results of our work, that it is difficult to comment on the statements in his letter. He has entirely missed the idea of purification in the series of intermittent sewage filters Nos. 12A, 15B and 16B, which have been described in our Reports for 1892 and 1893.

It seems to me unnecessary to comment on his scheme until he has some facts to give with regard to the bacterial and organic purification of water and sewage by his system. Truly yours,

George W. Fuller.

Lawrence, Mass., Feb. 16, 1895.

THE ELECTRIC MOTOR IN THE MACHINE SHOP.*

By Geo. Richmond, M. Am. Soc. M. E., Consulting Engineer, De La Vergne Refrigerating Machine Co.

A very great advantage has been found in the substitution of electric motors for local steam engines in such places as rolling-mills, dockyards, etc., and this was altogether to be expected. Some interesting data in this connection are contained in a paper read by D. Selby-Bigge before the Iron & Steel Institute. He instances a case where six steam engines, aggregating 94 HP., were replaced by motors aggregating 29½ HP. While it may be said that such figures prove too much, they unquestionably show that there are many cases where extravagant waste of power occurs in transmission; and if the advocates of other systems have slept upon their rights, it is perfectly just that electricity should step in and claim all the glory. Nevertheless, it would be interesting to compare with a so easily-won victory some other solution of the problem—say, for example, that of the gas engine operated with producer gas—for it is well known that gas engines do not fall off in economy with such frightful rapidity with decreasing size as do steam engines, and, moreover, the loss in transmission through pipes is trifling compared to that of steam.

Leaving out of consideration the substitution of motors for steam engines, there remain three forms of application of the principle of special interest to the mechanical engineer—namely:

1. The driving of isolated tools where convenience is a chief consideration.

2. The grouping of a number of machines around a motor, admitting of an infinite number of combinations —from that of two or three machines to that of all those on the same floor, or in the same shop.

3. The building-in of a motor as a part and parcel of each and every machine tool.

There are a number of examples in this country of the first method, among the best known of which are those of Fraser & Chalmers and the De La Vergne Refrigerating Machine Company. Probably many present have seen the arrangements in the latter case for driving the heavy tools in the erecting shop. The full advantage of direct coupling could not, of course, be obtained in this case, but the necessary countershafting is attached to the walls of the building, well out of the range of action of the traveling crane. There are in all nine motors of the C. & C. type, including three for the Morgan crane. The aggregate capacity is 75 HP. It is found by experience that a single 40-HP. dynamo is sufficient to supply these motors, although it is rather severely taxed when the crane is being operated at the same time that the planing machine is running on a short cut. The average HP. supplied by the driving engine during a test extending over six weeks was 24 HP. As this engine was of 100 HP., so chosen in view of possible extensions, we may deduct 10 HP. for friction, leaving an average of 14 HP. supplied to the dynamo. If there are still any advocates of the storage battery, such a case as this presents an opportunity of figuring on the economy of running this whole plant with, say, a 20-HP. engine, in combination with storage batteries.

With regard to the second method, we have much more valuable data in connection with the installation at Herstal, Belgium. In this case we have the advantage of the deliberate choice, based on a careful scientific inquiry, and the carrying out of the plan without any of the compromises necessary in plants already running. A reprint of two important papers, the one by Leon Castermans, Managing Director of the Government Rifle Factory at Herstal, and the other by Felix Meiotte, Engineer for the International Company of Electricity, which supplied the electric plant, has been made by the C. & C. Co. (143 Liberty St., N. Y.—Ed.), and should be in the hands of every one interested in the subject. It is hardly necessary to say that both these gentlemen are enthusiastic advocates of the system adopted; and since they have between them enumerated pretty nearly all the advantages of the same, I cannot do better than read these as propositions for the consideration of the members of this Society. Mr. Castermans, with the ardor of a proselyte, is willing to venture on debatable ground and somewhat broad generalizations. His statement of the advantages is as follows:

1. By the simplicity of its parts, the security against interruption is greater than in other mechanical systems.

2. The elimination of belts, cables, pulleys, countershafts, etc., diminishes enormously the chances of accident or interruption.

3. This system is the only one which will give accurate figures as regards power transmitted and delivered.

*Condensed from a paper read at the February "Engineering Evening" of the American Society of Mechanical Engineers.

4. This system it is which presents the smallest disproportion between effective work and the passive resistance of the transmitting device, and which consequently gives the highest average efficiency.

5. The quantity of masses in movement is less than from the point of view of future enlargements in a factory. In fact, as each of the motors takes its power directly from the main motive power, it is always possible to put in new motors without affecting the original installation.

6. Electrical transmission is especially advantageous in any other system.

7. From the point of view of interior service, it is the only system which offers the possibility of easily disconnecting each transmitting shaft, and, what is more, of varying the speed of each of the elements independently of the others, which can continue to run at their normal speed; this last point offers one of the greatest advantages in a factory.

8. Finally, when the machinery is started up this can be done without shock, electrical transmission operating as a veritable elastic buffer. In the same way, if the work calls for a sudden increase in power, the demand is communicated directly to the steam engine without affecting the speeds of the other machinery, while under the same conditions with a mechanical transmission a shock is produced which is felt throughout the whole system, and affects the speed of all the various masses in movement. Transmitting shafts need no longer be absolutely parallel; they can even be put in all directions, and this permits of laying out the plan of the workshops, taking only into consideration good conditions of manufacture, without having to consider in advance the position which shall be given to the shafting.

Mr. Melotte's statement as to the advantages is as follows:

1. It assures the complete independence of each main shaft.

2. It permits the stopping of one shaft without stopping the whole factory and without having to use devices which are expensive and which are always difficult to arrange for.

3. It permits of throwing in again a shaft which has been stopped, which is not the case with most systems.

4. It permits of overloads as easily as any other system; thus the motor No. 5 in the Great Hall at the Herstal factory, the normal output of which is 16 HP., ran for several days at 30 HP. without inconvenience.

5. It gives more security, should there be a hitch in the transmission, for the motors are provided with an apparatus which cuts out the current automatically when the load runs above the limit. It permits of placing shafts in all the possible positions, without having to bother about making correspondence with those already up.

6. It is less cumbersome. The motor can be put in a corner; the conducting wires will follow the ceilings or the walls, or are carried under ground, while mechanical transmissions take up considerable space with their shafts, bearings, pulleys and cables, and require a considerable outlay in repairs and oil.

7. It adapts itself with remarkable facility to any increase in the plant; two pieces of wire and the motor, and all is done.

The installation at Herstal consisted of nine 16-HP. motors, two 37-HP. motors, and five motors varying from 21 HP. to 3 HP. Each of these, with the exception of two, one of which drove a pump and the other a ventilator, drove a line of shafting. The guaranteed efficiencies were 90% for the dynamo, 98% for the conductors, and an average of 87% for the motors, giving a total efficiency of 76.6% at the motor. While it may be perfectly true that in the particular case at Herstal this efficiency is superior to that which any one was willing to guarantee for mechanical transmission, it is obvious that it is inferior to the recorded efficiencies in some American machine shops. Prof. Flather, in his work on "Dynamometers and Measurement of Power," gives a list of shops in which the per cent. lost in driving the shafting ranges from 15 to 50%, leaving out as exceptional case of 80%. It must be remembered that in comparing these shops with the Herstal factory, the friction of the shafts driven by the motors is still to be accounted for in the latter.

It will be observed that many of the advantages enumerated by Messrs Castermans and Melotte apply with even greater force to the third system—namely, that of the motor coupled directly to each tool. To these may be added the absence of overhead belting, unobstructed light, and absolute independence of each machine.

On the other hand, by the multiplication of small motors, the efficiency will be considerably reduced and the caretaking increased. So far as is known there is no machine shop equipped in this manner, unless, perhaps, that of the Crocker-Wheeler Co. A very near approach to it, however, so far as division of power is concerned, is to be found in the silk factory of Messrs. J. Forrest & Co., of St. Etienne, France, the description of which appeared in "The American Engineer" for December, 1894. Here are employed 60 motors of ⅓ HP. each, having an efficiency of 55%, driving ribbon and velvet looms by cord transmission. There are forty 1-HP. motors, each driving a loom by belt transmission. In addition to these there are five motors of power varying from 1 HP. to 3 HP., and two very small motors. The results at St. Etienne seem to be entirely satisfactory. It is obvious that the ultimate solution of the problem is a direct-coupled motor, although the first cost and the fear of an excessive amount of caretaking stand in the way of its adoption.

It would seem that the advocates of electrical transmission have exercised themselves to prove a proposition somewhat doubtful in itself and of extremely small importance when taken in connection with the machine shop. Relative economy has a certain importance when power is used to drive machinery of unvarying productive capacity, such as looms, etc., or automatic machinery in general. In this case the workman must be educated to go at the pace set by the machine. In a machine shop, on the other hand, the amount of work of the same kind and quality turned out by different men varies very considerably. After all, the question which the engineer will ask is: Will electrical transmission enable me to turn out work at less cost? If each present will make a mental calculation of the ratio between the total amount paid in wages, interest, and depreciation on machinery, and the amount paid for motive power in his own factory, I think he will find that the motive power is not much more than 1% of the wages, etc. If it could be proved that the adoption of electrical transmission would increase the production of each man 1% only, this would compensate for doubling up the cost for motive power. On the other hand, if the introduction of electrical transmission would involve a loss of only 1% in the efficiency of the workman and machine, it is frivolous to insist upon the relative advantage of a difference between a transmission efficiency of 10 or 20%, since there is an absolute loss equal to the total cost for motive power.

What shall it profit a man though he gain all these advantages enumerated, real and imaginary, and lose the sale of one machine because he cannot produce it cheaply enough?

Discussion.

Prof. Crocker.—Any one who looks for exact figures at this stage of electrical progress will be disappointed, because the exact figures in one case will be quite different from those in another. I claim, however, that the question whether it is satisfactory in the long run—whether the superintendent and workmen like it, will determine the success or failure of this application of electric motors rather than mere figures of efficiency or of output.

The greatest advantage of the electric motor is that the shop is entirely clear of belts and shafting. Mr. Richmond has said elsewhere that in an ordinary machine shop the tools are used almost continuously. Now I make the statement that in very few shops are all the tools used any considerable fraction of the time. I do not believe that the average load is over 30% of the total capacity. Figures have been made by my friend Mr. Lufkin which show from 25 to 27 and 28%. Those may possibly be low, but I should think that 35% would be almost high. Year in and year out, decade in and decade out, the shops do not run at anything like 50% of their full capacity, and the total number of hours during which the ordinary lathe is running compared with the total number of working hours in the year is very small. Again, we have many cases where the shop is running very light either from hard times or from taking stock, or some other reason. Only a few tools are operated—perhaps one single lathe or drill press. Under those circumstances the electric system can be run at perfect efficiency just as well as if the whole shop were running—nearly; whereas, the other system would be very uneconomical. This permits, for instance, overtime work to be done with a small connected engine and dynamo, perhaps 5 or 10 HP., with the minimum expenditure of power. That same work done by the ordinary system would require the main engine to be operated in most cases, because I assume you want to work some particular tool which, of course, would be the very one which you could not work without operating the entire plant.

Mr. Oberlin Smith.—Assuming only that electrical distribution causes no more or very little more loss than mechanical transmission, its other advantages are such that even now it seems to me that it will pay to equip machines with motors as fast as it can be properly done. I do not believe in putting a motor on a line of shafting and retaining all the old belts and countershafts. Eventually, a motor will be put on each separate machine. The clear space which we obtain by getting rid of belts will enable the use of a great variety of cranes adapted to the work in hand. The removal of belts and overhead gear will make shops cleaner, better lighted and less noisy, all of which goes to improve the morale of the workmen. Again, when the speed is under control each machine can be run at the speed best adapted to its work. A motor-driven machine will stop of its own accord if a sudden excessive overload is thrown upon it with no more harm than the blowing of a fuse; whereas, a belt-driven machine may seriously injure itself under similar circumstances, if the belt which drives it is a tight and heavy one.

The question as to the introduction of motors on individual machines depends on three things. First is the speed with which our inventors of machine tools and motors will adapt them to each other and get them simply and conveniently connected; second, is the matter of first cost of the motors; and, third is the cost of maintenance.

Mr. Fay.—We have given the matter serious consideration and we have come to the conclusion, subject to change without notice, that it is not always proper or profitable to put a motor on every machine. We do not believe the efficiency of a very small motor is high enough to pay for using it at all if we can possibly help it. To get down to figures, we have some 3-HP. motors that will give us a commercial efficiency of 88%, sometimes a little higher. A ½-HP. motor is a pretty good one at 60%. Taking 15 or 20% loss out of the belt transmission and putting it into a motor will not increase the dividends at all, and it very frequently happens that the increased first cost of a very small motor and the decreased efficiency which is the result of using it, will be a barrier which makes it more profitable to put several small machines of a kindred nature on one motor that has an appreciable efficiency. With that end in view we propose to have a motor, say, 3 HP., that runs at, say, 300 revolutions, or 250 revolutions per minute, and extend the motor shaft out, connecting up to it one to five small drills or lathes or other machines taking a fraction of a horse power each. I find that 20 ft. of armature shaft extension might add a loss of 1-10 HP. We start out with an efficiency for this 3-HP. motor of, say, 85%. Decreasing that with the loss of 1-10 HP., you have your total loss when you have a half-dozen more or less small machines running from one motor. Now, comparing that with six ½-HP. motors at an efficiency of 50 or 60%, we do not even need to guess at what the result will be. The question of speed is another matter. Mr. Smith mentioned the fact that rheostats are used for varying the speed. I might say this is another piece of antiquity for which we have very little respect. We are aware of the fact that rheostats have been used for this purpose, and I would not swear that they are not used now, but there is no need for them. In the past, motors were designed so that if we undertook to weaken the field to increase the speed, the reactive effects of the armature produced sparking on the commutators. We very soon had to send to the manufacturer for a new commutator, and they say repairs are legitimate prey. In order not to have to use a rheostat, because our commutator would wear out if we undertook to weaken the field in order to vary the speed, we built a new motor. That is the only remedy that we could find, and at the present time we have a motor that will give us a difference in speed of 100% without any sparking whatever. It is done by field commutation. All that is necessary in order that speeds may be changed is to get a motor that will not spark when the field is weak. That involves the necessity of studying the design carefully.

Mr. Platt called attention to the fact that the modern slow-speed motors are much more readily adapted to the mechanical engineer's designs than the high-speed motors which were at first generally introduced. He had driven a large band saw in the middle of a large mill yard with a 60-HP. motor with perfect satisfaction.

Mr. E. F. C. Davis.—The Southwark Foundry & Machine Co., of Philadelphia, were obliged a few years ago to go into the electric driving of certain machines. They were building Porter-Allen engines. They had not any tools suitable to handle the bed-plates, but they had quite a number of portable tools, such as the slotters, and they were led to take these tools to the work, because the work was too large to take to their machine, and they developed a very beautiful system of electric transmission.

Mr. Henderson.—In arranging the roof trusses of a building, if we are designing a building and intend to put in shafting, it is customary to increase the trusses in the neighborhood of 10%, and also arrange the trusses in even bays, so that they will support the shafting properly, and also to arrange the windows. If we do not have to pay any regard to this extra weight of the trusses, we can arrange the windows and trusses in a more satisfactory manner.

Mr. Binsse.—There are few manufacturing establishments that consume so little power as a machine shop. In one I know of, that employs over 100 men, and large engines are built, only about 35 HP. is used. In another about 50 men are employed, and the cost of power and heat together is only about $300 per year.

A brief discussion took place between Prof. Crocker and Mr. Ayer as to the best voltage for shop use. The latter favored 110 volts for ordinary plants, where distances are short. Prof. Crocker favored 250 volts, claiming that carbon commutator brushes had not sufficient conductivity for the lower potential.

Mr. Henry R. Towne, the chairman, pointed out that the discussion had been somewhat narrowed by confining it to machine tools, which use so little power that its economy is of small importance anyway. In many industries much larger amounts of power are used and the machines run substantially all the time; hence an economy in power would be of greater importance under such circumstances.

STREET RAILWAY STATISTICS FOR 1894.

We reprint from the "Street Railway Journal" the accompanying table, showing the miles of track of street railways operated by motive power of various types, and the number of cars. The statistics cover each state and are summarized for the United States. It should be especially noted that the miles are miles of track and not miles of road. The number of cars includes both motor cars and trail cars. The table shows that during the past year 1,461 miles of track were equipped with electricity, and the rolling stock of electric roads was increased by 5,721 cars. The cable roads and steam roads are about at a standstill, the variation shown being probably due to varying completeness in the statistics rather than to actual changes. Horse car lines decreased in number of cars and miles of track to about the same extent that electric lines increased. The total miles and number of cars for the country, as a whole, show only a small increase, indicating that the work of the year was the changing of horse car lines to electric, rather than in the construction of absolutely new lines.

Mileage of Track and Number of Cars of Street Railways in the United States in Dec., 1893, and Dec., 1894.

	December, 1893.										December, 1894.									
	Horse.		Electric.		Cable.		Steam.		Total.		Horse.		Electric.		Cable.		Steam.		Total.	
	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.	Miles.	Cars.
Ala.	21	72	82	142	...	....	137	146	240	360	36	92	79	144	...	....	148	112	263	348
Ariz.	5	2	5	8	...	....	....	....	10	10	5	4	5	3	....	....	....	....	10	7
Ark.	30	78	39	85	...	....	5	1	74	164	38	85	45	95	....	....	5	1	78	181
Cal.	219	488	266	467	163	742	50	25	698	1,722	231	706	251	403	156	630	49	79	687	1,818
Colo.	10	13	206	537	30	62	15	4	261	616	7	7	163	327	30	232	15	4	215	570
Conn.	35	52	210	592	...	....	....	....	245	644	107	417	72	158	....	....	....	....	179	575
Del.	...	....	24	65	...	....	....	....	24	65	6	22	13	50	....	....	....	....	19	72
D. C.	60	379	52	107	22	400	...	....	143	886	57	324	56	107	22	380	....	....	135	820
Fla.	24	57	11	21	...	....	....	....	35	78	28	55	5	10	....	....	....	....	33	65
Ga.	29	35	229	360	...	....	26	12	284	407	34	89	213	306	....	....	28	27	275	422
Idaho	...	....	3	2	...	....	....	....	3	2	....	....	3	2	....	....	....	....	3	2
Ill.	333	3,452	421	922	86	924	41	162	881	5,460	343	3,389	393	805	86	803	4	2	829	5,059
Ind.	29	43	289	640	...	....	8	18	306	701	92	167	173	402	....	....	8	14	273	583
Iowa	16	20	239	454	7	34	12	13	265	521	34	50	232	431	7	34	18	19	291	534
Kan.	36	46	116	207	...	....	11	27	163	280	54	111	108	160	....	....	11	22	173	205
Ky.	60	171	205	551	...	....	3	2	268	724	98	280	130	413	....	....	....	....	228	693
La.	45	152	150	278	...	....	....	....	195	430	98	334	50	103	....	....	9	36	157	473
Me.	28	62	70	138	...	....	....	....	98	200	28	52	48	93	....	....	....	....	76	145
Md.	24	130	177	402	36	132	2	2	239	666	59	283	110	267	37	200	2	4	308	743
Mass.	122	820	839	3,197	...	....	7	7	988	4,017	219	1,968	616	2,184	....	....	6	13	841	4,165
Mich.	60	335	250	648	...	....	9	13	319	996	51	296	249	637	....	....	9	11	309	854
Minn.	7	11	297	1,004	7	40	...	....	311	1,055	10	16	319	778	11	80	....	....	340	874
Miss.	13	23	....	....	....	....	6	30	19	53	21	54	....	....	....	....	6	10	27	64
Mo.	35	125	339	1,563	118	1,065	20	36	512	2,789	43	183	324	1,078	108	1114	22	30	497	2,405
Mont.	...	....	54	60	2	4	2	5	58	69	....	....	60	67	2	4	2	5	64	76
Neb.	51	68	141	331	7	22	...	....	199	421	52	91	160	297	6	36	...	....	218	424
N. H.	24	77	27	44	...	....	...	....	51	121	22	59	24	39	....	....	....	....	46	89
N. J.	73	292	310	780	2	2	1	6	386	1,080	167	609	202	500	1	2	8	15	378	1,186
N. Y.	401	3,288	877	2,289	40	495	95	1,938	1,413	8,010	629	4,275	758	2,215	39	408	112	1446	1,538	8,344
N. C.	5	7	37	71	...	....	7	5	49	83	5	7	30	53	....	....	7	7	42	67
Ohio	118	250	633	1,849	44	306	3	11	818	2,416	148	208	644	1,684	44	306	3	11	839	2,260
Ore.	7	8	100	187	8	24	25	21	140	240	7	8	91	173	8	23	31	39	137	243
Penn.	88	507	1,016	2,675	68	208	7	21	1,179	3,501	522	1,812	687	1,278	70	324	4	6	1,283	3,420
R. I.	3	2	128	420	3	58	...	....	134	480	68	353	51	89	3	58	....	....	122	500
S. C.	35	93	21	6	...	....	....	....	56	99	34	93	12	6	....	....	....	....	46	99
S. D.	17	13	11	7	...	....	7	1	35	21	17	16	9	7	....	....	6	2	32	25
Tenn.	18	21	173	363	1	2	69	85	261	471	23	50	202	332	....	....	73	57	208	439
Tex.	83	152	261	377	...	....	13	14	357	543	99	205	278	365	....	....	32	29	409	599
Utah.	...	....	89	120	...	....	6	?	95	120	....	....	86	128	....	....	6	2	92	130
Vt.	2	9	13	22	...	....	....	....	15	31	10	19	5	8	....	....	....	....	15	27
Va.	30	97	106	192	...	....	4	5	140	294	24	74	113	177	....	....	4	6	141	340
Wash.	7	8	203	181	18	63	...	....	228	252	7	8	221	250	27	77	16	5	271	257
W. Va.	10	18	20	58	...	....	9	27	48	103	13	19	34	85	....	....	....	....	47	104
Wis.	21	31	240	427	...	....	14	9	284	467	23	33	230	419	....	....	12	9	265	461
Wyo.	...	....	....	....	...	....	....	....	...	....	5	11	....	....	....	....	....	....	5	11
Total.	2,243	11,507	9,008	22,849	662	4,673	614	2,639	12,527	41,668	3574	16,875	7547	17,128	657	4789	656	2023	12,434	40,815

EFFECT OF FROST AND OF SULPHATE OF SODA TEST ON BUILDING STONES.*

By Lea McI. Luquer, Ph. D.

In the writer's experiments all chemical questions are left unconsidered, and the physical action only observed. The samples subjected to two methods of testing were always adjoining pieces of the same stone, and the shattering effects of hammering were avoided. Samples were made of approximately the same size, all sharp edges or loose particles were removed, and finally the surfaces brushed over with a stiff brush. They were then dried in an air bath at 248° F., and weighed on a chemical balance. Fourteen kinds of stone were examined, covering most of the building stones in use.

Previous experiments by others have proved that hot solutions will destroy stones which will resist the action of frost and cold-saturated solutions. In the present experiments, after the preparation and weighing mentioned, the specimens were boiled in the sulphate of soda solution for half an hour, to obtain complete saturation, after which the solution was poured off, and the specimens washed. They were then again immersed for several hours in a fresh solution, and afterwards suspended by threads in a dark room for 12 hours. The next day they were soaked during the day, and hung during the night, this operation being performed eight times with each. In two cases the experiments lasted 10 days. All the specimens were then sprayed, to remove adhering particles, dried as before, and weighed. In the freezing tests the specimens were allowed to thaw and soak during the day, and were hung up and frozen during the night. The temperature of the cold room was from 4° to 10° F., and that of the warm room about 85° F.

The results showed very decidedly the greater effects to be from the soda solution. The effect of the solution was greatest on pure limestone, while that of frost was most marked on coarse-grained dolomite. The effects of both methods on sandstones were least on the fine grained, while all were much more affected than either limestones or granites. A specimen of pressed brick was more acted upon by both methods than either limestones or granites.

*Abstract of a paper to be presented before the American Society of Civil Engineers on March 6.

A NEW RAILWAY VELOCIPEDE.

The railway velocipede shown in the accompanying illustration is an adaptation of the design of the safety bicycle to track service, the machine having a flanged tire on the front wheel and a blind tire on the rear wheel, and being held upright by a brace carrying a small guide wheel, with flanged tire running on the opposite rail. The larger wheels are 24 ins. diameter, with 32 tangent spokes of No. 12 wire, and the rims are of No. 16 steel, with an outward bead on the outer edge and an inward bead at the middle, to increase the stiffness. The small wheel is 11 ins. diameter, and is journaled on the end of a pivoted arm, which, by unhooking the end of the brace rod from the back of the frame, may be swung back against the frame for shipment in a baggage car, or on the platform of a passenger car. The space occupied, when thus folded, is only 6 ft. x 1 ft. 6 ins., a little more than that required for a road bicycle. The flanges of the front wheel and guide wheel are made of the M. C. B. standard outline, and the flat tire of the rear wheel is wide enough to eliminate all danger of slipping off the rail. The frame holds the two wheels rigidly in line, but the rider can guide the front wheel on curves and at frogs and switches, and so secure easy riding with less wear on the flanges and less liability to derailment at worn switches and frogs than where the flanges are relied upon to do all the guiding, as in the ordinary style of track velocipede. The wheels have rubber bands 3 ins. wide and 3-16 in. thick on the tread, which make the machine run easily without jar, and also without noise, so that the rider can catch the sound of approaching trains, while they also make the machine run more safely at high speed when the rails are wet or frosty. The hubs have ball bearings of the latest dust-proof pattern, and the bearings, cranks and pedals, driving chain and gearing, saddle, handle bars and other parts are of standard patterns as used on road bicycles, so that repairs and renewals can be readily made at bicycle stores. The frame is of No. 16 Shelby seamless steel tubing, with drop-forged connections thoroughly brazed.

A toolbox can be hung from the top horizontal bar of the frame, and a front seat and footrest can be attached to the front vertical bar for carrying a second rider. The weight of the machine is 55 lbs., or 60 lbs. with the second seat attached. This velocipede was designed by Mr. G. W. Miller, of the Kalamazoo Railroad Velocipede & Car Co., and is being manufactured by that company. It is interesting to note that a similar application of the old-fashioned bicycle, with one high wheel and one small rear wheel, was tried some time ago on the Transcaspian Railway, of Russia, the wheels having grooved tires and the machine being supported by an arm carrying a guide wheel running on the opposite rail.

Fig. 1. New Track Velocipede.

Fig. 2. New Track Velocipede with Toolbox and Extra Seat Attached.

The Port Royal, S. C., timber dry-dock, built by the U. S. Government, will be available for use in about two months, according to a Washington item. An approach to the dock has yet to be dredged.

A bill has been introduced in the Connecticut legislature placing all the highway bridges in the state that are 50 ft. or more in length under state control, and obliging the state to build, repair, and maintain all such bridges henceforth.

STATIC FRICTION.*

By C. M. Broomall.

By staticfriction is here meant the resistance one body offers to the motion of another sliding upon it just at the instant of starting (which is much greater than the friction of motion), and the coefficient is the ratio this bears to the normal pressure. The writer has made a series of experiments upon various surfaces, more particularly to determine the power required in the movement of head-gates. The apparatus used was so arranged as to allow considerable variations of pressure; 20 or 30 trials were made under each load, and the average of all readings was taken. He draws a series of conclusions as follows:

The coefficient of static friction is nearly constant under varying pressures, and is practically independent of the area of contact.

Average coefficients of static friction are as follows:

	Dry.	Wet.
Cast iron on cast iron	.3114	.3401
Pine on pine	.4738	.6350
Cast iron on pine	.4702	
Steel on steel	.4408	
" tin	.3648	
" cast iron	.2303	
Cast iron on tin	.4541	

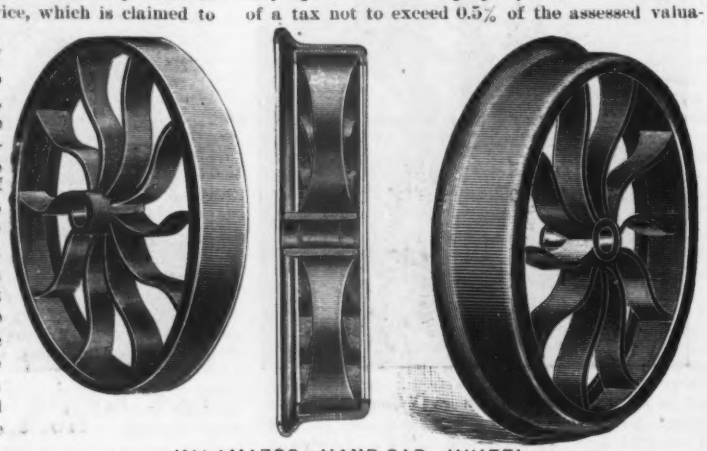
Under the same pressure per square inch, the static coefficient decreased as the area of contact increased.

For cast iron on cast iron the coefficient decreased as the pressure per square inch increased. For dry pine on dry pine, the coefficient increased as the pressure per square inch increased. In no other case was this true. Cast iron on pine gave slow decrease in coefficient with increase of pressure. Steel on steel gave marked decrease with increase of pressure. Steel on tin gave decrease with increase of pressure. Steel on cast iron, very marked decrease with increase of pressure. Cast iron on tin gave decrease with increase of pressure. Continuance of pressure for a length of time gave but slight increase in the coefficient, in the case of dry pine on pine, cast iron on tin, or cast iron on pine. With wet pine on pine and all the other combinations, the increase was marked.

The curves obtained by plotting the results showed a tendency to uniformity after certain pressures are reached. A preliminary "slip" of 1-16 to ⅛ in. was noted in the case of cast iron on cast iron, or steel on cast iron (especially under high pressures), with an increase in the power required to produce motion. The effect of wetting the surface of cast iron on cast iron, or pine on pine, is to increase greatly the coefficient. The writer stated that the differences between the average coefficient and the extremes in any series was from 1 to 4%, and that for this reason the average of a large number of trials was necessary.

THE KALAMAZOO HAND-CAR WHEEL.

Various special designs of wheels have been made for use on hand-cars, the object being to combine lightness and cheapness with strength and durability. We illustrate herewith a new pattern of wheel for this class of service, which is claimed to meet these requirements.



KALAMAZOO HAND-CAR WHEEL.

The wheel is composed of but two parts and has no bolts or rivets. The hub, spokes and rim of the wheel center are of malleable iron, made in one piece, and the rim is of channel section, in order to increase its stiffness. The tire is of steel, without a weld, being made from a solid blank, and is shrunk upon the wheel center, the rim of which reinforces the tread. The spokes are curved, so that a certain amount of spring is secured in the wheel itself. The rim is turned to fit a 20-in. tire and may be applied in repairs to the tires of old wheels whose centers have worn out. This wheel is being introduced by the Kalamazoo Railroad Velocipede & Car Co., of Kalamazoo, Mich., and has been protected by patents. It will be used on all this company's hand and push cars, instead of the plate center wheel illustrated in our issue of May 12, 1892, and we are informed that several hundred wheels of this new pattern are now in service and have proved very satisfactory to the railways using them.

*Abstract of a paper to be presented before the American Society of Civil Engineers on March 6.

WEATHER TABLE FOR JANUARY, 1895. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	15.8	39	—15	54	8.1	40	S	1.99	.87	11
	Portland, Me.	22.0	42	—4	46	6.7	34	E	2.47	.62	10
	New York, N. Y.	30.1	55	10	45	10.6	36	W	5.64	1.97	11
	Pittsburg, Pa.	27.0	58	—5	63	8.3	28	W	4.16	1.15	21
	Chicago, Ill	17.4	51	—9	60	18.1	64	SW	2.15	.91	14
	Omaha, Neb.	18.6	63	—12	75	8.1	30	NW	.35	.27	3
	St. Paul, Minn.	6.0	34	—22	56	8.2	36	W	1.05	.36	11
	Duluth, Minn	7.8	32	—20	52	7.9	26	NW	.75	.33	14
	Bismarck, N. Dak	—1.3	38	—32	70	8.9	31	NW	.89	.26	12
	Average	15.8	46	—12	58	9.4	37		2.16	.75	12
Southern Cities.	Washington, D. C.	31.6	62	4	58	6.7	28	NW	4.42	1.35	13
	Louisville, Ky.	29.2	62	—10	72	10.1	39	SW	4.54	1.15	16
	St. Louis, Mo	26.2	64	—8	72	12.8	56	SW	1.65	.76	11
	Savannah, Ga	50.4	74	23	51	8.1	32	N	5.02	1.63	11
	Kansas City, Mo	24.0	65	—8	73	8.3	34	NW	.32	.24	5
	Jacksonville, Fla.	56.1	79	26	53	7.2	31	SW	4.63	1.67	12
	Chattanooga, Tenn.	37.9	65	5	60	8.2	41	W	6.58	1.45	15
	New Orleans, La.	52.9	77	27	50	9.6	32	N	7.19	4.06	14
	Memphis, Tenn.	37.8	72	7	65	8.5	38	NW	5.94	2.70	11
	Palestine, Tex.	46.0	78	18	60	7.2	27	NW	2.42	1.54	10
	Average	39.1	70	8	61	8.7	36		4.27	1.66	12
Western Cities.	Helena, Mont.	17.2	51	—15	66	4.7	46	SW	1.95	.45	16
	Port Angeles, Wash	37.1	56	26	30	4.8	16	E	5.91	1.22	18
	San Francisco, Cal	48.6	63	38	25	9.5	44	S	6.99	1.96	13
	Salt Lake City, Utah	29.7	52	—0	52	6.1	48	S	1.32	.29	15
	Santa Fe, N. Mex	28.2	48	—4	52	7.1	31	SW	1.51	.73	8
	Denver, Colo.	28.4	62	—7	69	7.8	37	NW	.32	.17	4
	Yuma, Ariz.	54.6	75	35	40	7.4	39	SE	.58	.58	1
	Average	34.8	58	10	48	6.8	39		2.63	0.80	11

FINANCIAL CONDITION OF THE CHICAGO DRAINAGE CANAL.

The additional sum of $8,500,000 is needed to complete the Chicago Drainage Canal, according to the latest revised estimates of the engineers. This amount is required over and above the balance now in the treasury and all receipts up to the end of 1896, assuming, of course, that the present assessed valuation of property is not materially increased. In round figures, there is now in the treasury of the Sanitary District a little over $6,000,000. This sum will carry on work at the normal monthly rate of progress until November or December of this year, when, unless additional money is secured, work will have to be stopped. In a recent report of the Board of Trustees' Committee of Engineering and Finance, the present financial condition and the future needs of the Sanitary District are pretty fully canvassed. The following are the principal facts brought out in this report:

The general law under which the Sanitary District of Chicago was organized provides three ways of raising money for corporate purposes. (1) By a levy upon the taxable property within the district of a tax not to exceed 0.5% of the assessed valuation; (2) by authority to borrow money and issue bonds therefor to an amount not to exceed 5% of the assessed valuation, provided that this 5% does not exceed $15,000,000; (3) by authority to raise money by special assessment. It has been found impracticable to raise money by special assessments, and thus far all the money has been secured from the sale of bonds and by taxation. Not only was it thought that these two means of raising money would be ample, but there was some fear that, on account of the increase of the assessed valuation likely to take place, it would be possible to raise money in excess of what was needed, and so the limitation of the total indebtedness to be incurred to $15,000,000 was provided for in the law. This increase in the assessed valuation has not taken place, and, as a consequence, the receipts from both taxes and bonds have been considerably less than was expected. Even, however, had the assessment increased to $300,000,000, which would have allowed an issue of $15,000,000 of bonds, the present available funds of the district would have been increased by only about $4,000,000, which would have still made it necessary to secure more money to complete the canal.

As is shown in detail in the accompanying table, the sum of $8,500,000 is needed over and above all money which can be raised up to the end of 1896, providing the present assessed valuation of property, tax rate or limit of bonded indebtedness is not changed. Two methods of raising this money present themselves, either by increasing the limit of bonded indebtedness or by raising the tax rate. Any amendment to the present law, providing for an increased bonded indebtedness, must pass the State Legislature by a two-thirds vote, and be ratified by a majority vote of all the electors voting in the district at the next election for members of the General Assembly. Nothing could, therefore, be decided until the November elections, and then it is quite possible that the amendment might fail of receiving the necessary votes from the mere indifference of the voters, even if no negative votes were cast. This possibility is increased by the system of voting, which requires that the voter shall put a cross opposite the word "for" or "against," making such a vote entirely an act of volition on the part of the voter.

For these reasons the committee thinks it advisable to confine efforts for securing more money to an increase of the tax rate, and they accordingly recommended that the present law be amended so as to empower the levying of a 1½% tax, instead of a ½% tax for the three years of 1895, 1896 and 1897. This would produce, during the three years, in addition to the amount which it is possible to secure under the present powers of the district, the sum of $7,350,000. This amount falls short of the sum required, but it is hoped that the assessed valuation of the property in the district will be raised sufficiently to ensure the additional amount necessary. A bill, embodying the ideas of the committee, has been introduced into the Illinois legislature.

Table Showing Estimated Cost of the Chicago Drainage Canal and the Present Available Resources for Constructing it.

	Resources.	Estimated cost.
Taxes to Dec. 31, 1894	$4,295,315	
Taxes for 1895 and 1896	2,302,000	
Sale of bonds	12,000,000	
Other receipts	200,000	
	$18,797,315	
Work contracted for		$18,991,078
Work to be contracted for		2,883,899
Right of way		2,600,000
Administration		1,828,238
		$27,303,215
Balance	$8,505,900	
	$27,303,215	

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PERSONALS.

Mr. T. H. Spencer has been appointed Division Superintendent of the Southern Ry., with office at Oxford, N. C.

Mr. G. B. Renton, who has been Secretary of the Grand Trunk Ry. for 20 years, died at London, England, recently.

Mr. E. L. Corthell, M. Am. Soc. C. E., is at Berne, Switzerland, where he has undergone an operation for the removal of one of his eyes.

Mr. J Nelson Patrick, of Omaha, Neb., has been appointed Government Director of the Union Pacific Ry., vice the late Mr. J. W. Paddock.

Mr. W. G. Gotshall has been appointed Chief Engineer of the Union Depot Ry., St. Louis, Mo., in charge of the electrical and mechanical departments.

Mr. W. L. Hearn, proprietor of the Riverside Iron Works, Wheeling, W. Va., died Feb. 13. He was born in Delaware in 1817 and went to Wheeling in 1867.

Mr. E. J. Pearson has been appointed Superintendent of the Yellowstone & Missouri River divisions of the Northern Pacific R. R., vice Mr. John Dorsey, deceased.

Mr. E. R. Minturn has been appointed Superintendent of the Lake Superior Division of the Chicago, Milwaukee & St. Paul Ry., vice Mr. H. M. Bell, resigned.

Mr. John H. Gordon, one of the inventors of the Gordon harvester, which was the first combination reaper and binder, died at Rochester, N. Y., Feb. 12 at the age of 55.

Prof. Charles L. Doolittle, of the Department of Mechanics and Astronomy in Lehigh University, has resigned in order to accept a similar position in the University of Pennsylvania.

Mr. C. J. Stedwell, Superintendent of the Cleveland Division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed Division Superintendent of the Chicago & Northwestern Ry.

Mr. C. E. Fowler, Chief Engineer of the Youngstown Bridge Co., Youngstown, O., has been made Acting General Manager during the illness of Mr. J. P. Kennedy, Vice-President and General Manager.

Mr. George S. Morison, M. Am. Soc. C. E., has removed his Chicago office from 184 La Salle St. to room 1742, Monadnock Block, corner of Jackson and Dearborn Sts. His New York office remains at 35 Wall St.

Mr. Harry Fox, Assistant Superintendent of the Iowa Division of the Chicago, Rock Island & Pacific Ry., has been appointed Superintendent of the Kansas & Nebraska Division, with offices at Harrington, Kan.

Mr. Robert Hazlett, formerly with the Young Lock Nut Co., has entered into partnership with Mr. Gilmor Brown, of Wheeling, W. Va., under the firm name of Brown & Hazlett, for carrying on a general engineering business.

Mr. Robert Morrell, inventor of the Morrell steel tie now undergoing trial on the Delaware, Lackwanna & Western R. R., and also of metal tie plates, rail joints and other railway appliances, died at Summit, N. J., Feb. 13, at the age of 59.

Mr. George C. Smith died in Chicago on Monday. Mr. Smith was born in Potsdam, N. Y., in 1838. He superintended the construction of the Western Railway of Uruguay, five years ago, and was formerly Assistant Chief Engineer of the Burlington road.

Mr. William B. Adams, contracting painter, who has had the contract for painting the Brooklyn Bridge for several years, and has had large contracts on the elevated railways of New York and Brooklyn, died in New York city Feb. 12. He was born at Baltimore, Md., in 1836.

Mr. Loren Packard, Master Car Builder of the New York Central R. R., at West Albany, N. Y., died last week. He was born in New Hampshire in 1843. For ten years he was foreman of the Wason Car Mfg. Co., at Springfield, Mass., and became Master Car Builder of the New York, New Haven & Hartford R. R. in 1876, of the Baltimore & Ohio R. R. in 1881, and of the New York Central R. R. in 1884.

Lieut. Fremont P. Peck, of the U. S. Ordnance Corps, was killed at Sandy Hook on Feb. 19 by the bursting of the breech of a 4.7-in. Hotchkiss rapid-fire gun during a test. Lieut. Peck was a native of New York, and was graduated from West Point on June 27, 1887, and appointed 2d Lieutenant of the 2d Artillery. U. S. Army. He was subsequently transferred to the Ordnance Corps and was on duty at the U. S. proving grounds at Sandy Hook.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

INDIANAPOLIS ENGINEERING CLUB.
Feb. 23. "Multiphase Currents of Electricity" by T. Varney. Secy. C. C. Brown, City Engineer.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 26. Secy., H. Breen, 36 Jacobson Block.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 27. "Notes on Recent Electrical Engineering Developments in France and England," by H. W. Leonard. Secy., R. W. Pope, 12 W. 31st St., New York city.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 1. Secy., O. H. Von Geldern, 719 Market St., San Francisco.
FRANKLIN INSTITUTE, PHILADELPHIA.
March 1. "Metallurgy of Aluminum," by A. E. Hunt. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
ENGINEERS' CLUB OF PHILADELPHIA.
March 2. Secy., L. F. Rondinella, 1122 Girard St.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
March 4. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
WESTERN SOCIETY OF ENGINEERS.
March 6. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
March 6. "Timber Physics," by J. B. Johnson. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 6. "The Relative Effects of Frost and the Sulphate of Soda Efflorescence Test on Building Stones," by L. M. Luquer; "Static Friction," by C. M. Broomall. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 7. Secy., C. H McLeod, 12 Mansfield St., Montreal.
MONTANA SOCIETY OF CIVIL ENGINEERS.
March 9. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
WISCONSIN POLYTECHNIC SOCIETY.
March 11. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
March 11. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 12. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 12. Secy., F. C. Osborn, Case Library Building.
NORTHWESTERN RAILWAY CLUB.
March 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NEW ENGLAND RAILROAD CLUB.
March 13. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
March 13. "Rapid Transit in Large Cities," by W. B. Parsons. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
March 14. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
March 14. Secy., H. D. Ruhm, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 15. Secy., D. W. Meeker, St. Paul, Minn.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 18. Secy., E. Nexsen, Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
March 19. Secy., W. F. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
March 19. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 20. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
March 20. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 20. Secy., S. E. Tinkham, City Hall. Rooms, 36 Bromfield St.
NEW YORK RAILROAD CLUB.
March 21. Secy., John A. Hill, 256 Broadway, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
March 21. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
March 21. Secy., J. F. Wilson, Odd Fellows' Temple.
CENTRAL RAILWAY CLUB.
March 27. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The adjourned quarterly meeting was held at Young's Hotel, Boston, Feb. 18. Mr. Geo. C. Whipple, Biologist for the Boston Water-Works, read a paper entitled "Some Observations on the Temperature of Surface Waters and the Effect of Temperature on the Growth of Micro-Organisms," and Mr. A. W. F. Brown, Registrar of the Fitchburg water-works, read a paper on a "Card System of Service Connections." The usual short experience papers were also on the program.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.—The annual meeting was held in Boston, Mass., Feb. 13, with the President, Mr. Charles H. Nettleton, of Birmingham, Conn., in the chair. The President's address discussed the improvements in gas making and service, and referred to the increasing demand for elaborate and ornamental design of fixtures. Among the papers read were "A Cubic Foot of Gas," by Charles D. Lawson, of Worcester, Mass.; "The Best Course to Pursue When a Person is Overcome by Gas Inhalation," by Dr. Robert Armory, of the Brookline Gas Co., and "Card Catalogues in Use for Record of the Outside Work of a Gas Company," by S. J. Fowler, of Springfield, Mass. Officers were elected as follows: President, Charles D. Lawson, of Worcester, Mass.; Vice-Presidents, Samuel J. Fowler, of Springfield, Mass., and W. R. Addicks, of Boston; Secretary, Charles F. Prichard, of Lynn, Mass.; Directors, Frank S. Richardson, of North Adams, Mass.; Charles D. Sherman, of New Haven, Conn.; Waldo A. Learned, of Newton, Mass.; N. W. Gifford, of New Bedford, Mass.; and J. A. Coffin, of Gloucester, Mass.

CIVIL ENGINEERS 'CLUB OF CLEVELAND.—At the last meeting Col. J. A. Smith, U. S. Engineer Corps, read a paper on "The Engineering of Crib Construction as Applied to Harbor Improvement," dealing with the construction and effects of the Cleveland breakwater.

ENGINEERS' CLUB OF CINCINNATI.—The officers elected for the year 1895 are as follows: President, M. D. Burke; Vice-President, Chas. A. Ewing; Directors, L. C. Fritch, C. E. Lindsay and C. H. Meeds; Secretary and Treasurer, J. F. Wilson. The official address of the club is P. O. Box 333, and of the Secretary, Room 504, Odd Fellows' Temple. Regular meetings are held on the third Thursday in each month, except July and August, at the Literary Club rooms, 24 West 4th St., at 7:30 p. m. J. F. Wilson, Secy.

WESTERN RAILWAY CLUB.—The regular monthly meeting of the club was held at the Auditorium Hotel Feb. 19. The first part of the session was devoted to a discussion of the paper on "English Railway Practice," read at the January meeting by Mr. F. A. Delano, and to a general discussion of Stationary Boiler Practice and Shop Heating. These discussions were followed by a report of the committee on the Revision of Interchange Rules, and by a paper entitled "Notes on Modern Practice in Signalling," by Mr. Geo. Gibbs, Mechanical Engineer, Chicago, Milwaukee & St. Paul Ry.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—The following is a list of officers for the current year: President, H. B. Stevens; Vice-President, K. B. Hilgard; Secretary, C. L. Annan; Treasurer, A. O. Powell; Librarian, A. W. Munster; representative on the Board of Managers of the Association of Engineering Societies, E. E. Woodman. Meetings are held on the first Monday of each month, excepting June, July, August and September. C. L. Annan, Secy.

MONTANA SOCIETY OF CIVIL ENGINEERS.—At the meeting on Feb. 9, Mr. A. E. Cummings, of the committee on county surveyor and road laws, reported that both bills, substantially as adopted by the annual meeting, had been introduced in both houses of the legislature, and that several meetings of the legislative committees had been held, but no final action taken. It was voted that the committee be continued and requested to take all necessary steps to urge the passage of the two measures. Mr. Cummings also reported, for the committee on water measurement, that the proposed act adopted by the annual meeting had been presented to both branches of the legislature; that it had passed the Senate, and that it is now before the House committee on irrigation. The secretary read a paper by E. H. Beckler upon the location and construction of the United Verde & Pacific Railway, which was constructed under his direction as Chief Engineer for the Hon. William A. Clark, of Butte, and completed Dec. 1, 1894. Letters were read commending the action of the society in its efforts to obtain some action by the legislature giving a legal definition of a miner's inch, and also commending the action of the society in beginning a movement for the more economical expenditure of the road tax of Montana. The officers elected for the current year are as follows: President, James S. Keeri, of Helena; Vice-Presidents, Augustus M. Ryan, of Bozeman, and James M. Page, of Twin Bridges; Secretary and Librarian, Forrest J. Smith, of Helena; Treasurer, A. S. Hovey, of Helena; Trustee, Chas. W. Goodale, of Butte; member of the board of managers of the Association of Engineering Societies, James S. Keeri. Regular meetings are held on the second Saturday of each month at the rooms of the society, No. 8 Denver Block, Helena, Mont. Forrest J. Smith, Secy.

DENVER SOCIETY OF CIVIL ENGINEERS.—The officers elected for the current year are as follows: President, E. P. Martin; First Vice-President, W. W. Follett; Second Vice-President, Geo. H. Angell; Secretary and Treasurer, H. Breen, 36 Jacobson Building; Librarian, J. H. Titcomb; Executive Committee, J. C. Ulrich, J. H. Titcomb, and P. H. Van Diest. Meetings are held on the second and fourth Tuesdays of each month, except July, August and December, when they are held on the second Tuesday only.

H. Breen, Secy.

NEW PUBLICATIONS.

FEBRUARY MAGAZINES.—In "Scribner's" Mr. John R. Spears describes a visit to Patagonia and Tierra del Fuego, regions about as far removed from the current of civilization as any part of the globe. From what Mr. Spears tells us, however, it seems likely that this little-known country may yet acquire fame by its product of gold, and that parts of it are capable of supporting a thrifty agricultural population. In the "North American Review" Lieut. J. T. Knight, U. S. A., tells how to repel train robbers. He would have the express car put at the rear of the train instead of next the engine, and argues that it would then take a large gang of robbers to "hold up" at one time the engine crew, at the one end of the train, and the express messengers at the other end. Thus the "swag" would have to be divided among so large a number that the share of each would be small, and train robbing would become unprofitable. But, on the other hand, if the express car is the point of attack, it doesn't look like good generalship to place it at the rear of the train. It would be an easy matter to cut off the rear car, and even if an automatic alarm were thus sounded in the rest of the train, as Lieut. Knight proposes, the rear car could thus be separated a considerable distance from the rest of the train and one robber with a magazine rifle would probably deter any one from coming back to the rescue while the express car was being looted. In "McClure's Magazine" we find a graphic account of the express robbery on the Chicago, Rock, Island & Pacific Ry., on March 12, 1886, and the tracing and final capture and conviction of the robbers by the Pinkerton detective agency. Another article in the "North American Review," by Senator O. H. Platt, explains the Indian Territory problem, and urges that the present anomalous and inefficient Indian governments be abolished and the region be placed under the jurisdiction of the National Government.

In "The Forum" Col. Carroll D. Wright has a paper on "Steps Toward Government Control of Railways," a title which should not be misunderstood to mean government ownership or government operation, as it has no reference to such schemes The paper discusses especially the railway labor problem, with special reference to the bill for settling railway labor disputes which is now pending in Congress. Col. Wright urges that organizations of employers or employees should be given the same powers for combination and agreement that are given to ordinary corporations, and that it is unfair to grant governmental control so far as the employers' interests are affected, while still leaving the doctrnie of "Laissez Faire" to have its full operation upon the other element, labor. Mr. Louis Windmuller writes on "The Barnacles of Fire Insurance," and the article well sets forth the evils which beset the present system of management of the fire insurance business. In 1890 Berlin's fire loss was 22 cts. per head of population; New York's, $2.81; Chicago's, $2.44; and Brooklyn's, $1.89. The percentage of losses to premium receipts in the United States has increased from 61.23% in 1891, to 62.08% in 1892 and 66.93% in 1893. "If shareholders will not soon adopt measures for proper management," says Mr. Windmuller, "they will see their capital and surplus vanish like that of 878 fire insurance companies whose assets have gone up in smoke since 1860."

In the "Review of Reviews," Clark Howell, editor of the "Atlanta Constitution," tells of the Cotton States and Industrial Exposition, which he calls "The World's Event for 1895." In "The Century" we find a symposium on Prof. Sargent's scheme of forest preservation, contributed to by the principal authorities on forestry. There is also an excellent illustrated description of the "New Weapons of the United States Army." It is indeed wonderful that so much in the way of the improvement of this branch of our national defences should have been accomplished in the past eight years. The article, though written for the non-technical reader, it is so well prepared that it will interest even those who are somewhat familiar with its subject.

GEOLOGICAL SURVEY OF NEW JERSEY. Report for the Year 1893. 8vo; stiff paper; pp. x., 452; illustrations and maps. Address John C. Smock, State Geologist, Trenton, N. J.

A portion of this report by Mr. C. C. Vermuele, Consulting Engineer and Topographer of the Survey, is entitled "Water Supply and Water Power," and another section, by Mr. Lewis Woolman, is on "Artesian Wells in Southern New Jersey." These parts of the report contain much information of value to those interested in the possible sources of water supply for New Jersey cities. Mr. Vermuele's report is supplemented by a map showing by colors and hatching utilized and unutilized gravity and pumping supplies from streams. The location and area of the various watersheds are thus shown graphically, while the text gives elevations and daily capacities in gallons and certain figures for each water supply system in the state. Stream pollution is also ably discussed by Mr. Vermuele, a number of streams being taken up in detail. A final report on water supply and water power is said to be in press.

Mr. Woolman describes a number of wells recently sunk, thus continuing an interesting record. Other branches of the survey are ably handled by various writers.

A GENERAL SPECIFICATION FOR STRUCTURAL STEEL. By Clay, Cunningham & Stowell, The American Engineering and Inspection Association. 10 cts.

NOTES, EXPLANATORY AND DESCRIPTIVE, in connection with the General Specifications for Structural Steel. By Clay, Cunningham & Stowell. No. 51 State St., Albany, N. Y. 15 cts.

The first of these published sheets is in the form of a standard blank specification, to be filled up by the engineer as occasion may demand. It contains tables of physical requirements, qualities and elements, with an outline of the tests demanded, chemical and physical, and the character of the finished product. The requisite elastic limit and the allowances for thickness are also noted. The "Notes" accompanying these specifications more fully explain the views of its authors with regard to the quality and properties of structural steel. Especial stress is laid upon the quality of the steel, or its internal structure as indicated by the presence or absence of blowholes, sponginess, etc. The authors believe that too few specifications recognize the importance of this element of quality but put too much reliance upon the physical or chemical characteristics of steel for structural purposes. Some extracts from the "Notes" were reprinted in our last issue.

METROPOLITAN SEWERAGE COMMISSIONERS OF MASSACHUSETTS.—Report for the year ending Sept. 30, 1894. Howard Carson, Chief Engineer. 8vo; paper; pp. 151; large folding map and plates. Address the Commissioners, 110 Boylston St., Boston.

Mr. Carson describes in detail in this report the work of the year, and accompanies his description with reproductions of line drawings and photographs. The work of the Commission is now nearly finished. A number of articles on this subject were published in Engineering News during the first half of 1894.

COLORADO AGRICULTURAL EXPERIMENT STATION. Report for the Year 1894. Prof. L. G. Carpenter, Meteorologist and Irrigation Engineer. 8vo; paper; pp. 112; illustrations. Address Alston Ellis, Director, Fort Collins, Colo.

This report details the work of the year, including experiments in irrigating crops.

TRADE PUBLICATIONS.

WESTINGHOUSE ENGINES.—Westinghouse Machine Co., Pittsburg, Pa. 8vo.; pp.—illustrated.

This is one of the best trade catalogues which we have received for some time. It contains a full description of the Westinghouse single-acting automatic steam engine, with numerous elevations and sectional views of the engines and details of the several parts, views in the different shops and departments, and specimens of indicator diagrams, etc., Up to the end of 1892 the sales of the company had aggregated 5,821 engines, representing 270,501 HP. The book is beautifully printed and the illustrations are admirable.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Feb. 23.	Pipe sewers,	Elizabeth, N. J.	Feb. 7
Feb. 23.	Brick paving,	Cincinnati, O.	Feb. 14
Feb. 23.	Brick paving,	Des Moines, Ia.	Feb. 21
Feb. 23.	Cement curbing,	Des Moines, Ia.	Feb. 21
Feb. 23.	Paving Turtle Creek,	Pa.	Feb. 21
Feb. 23.	Turntable drum,	Milwaukee, Wis.	Feb. 21
Feb. 25.	Macadamizing,	Stapleton, N. Y.	Feb. 7
Feb. 25.	Iron bridge,	Cincinnati, O.	Feb. 7
Feb. 25.	Court-house bonds,	Waxahachie, Tex.	Feb. 7
Feb. 25.	Filling ravine,	San Francisco, Cal.	Feb. 7
Feb. 25.	Building work,	New York, N. Y.	Feb. 14
Feb. 25.	Paving,	Dayton, O.	Feb. 14
Feb. 25.	Brick paving,	Waterloo, Ia.	Feb. 14
Feb. 25.	Brick sewer,	Jersey City, N. J.	Feb. 14
Feb. 25.	Bridges,	Des Moines, Ia.	Feb. 14
Feb. 25.	Electric light bonds	Webb City, Mo.	Feb. 21
Feb. 25.	School buildings,	Chicago, Ill.	Feb. 21
Feb. 25.	Grading (3,000 cu. yds.),	Denver, Col.	Feb. 21
Feb. 26.	Jail,	Beaumont, Tex.	Jan. 31
Feb. 26.	Plans for 2 school bldgs.,	Milwaukee.	Feb. 7
Feb. 26.	Court-house,	Sparta, Wis.	Feb. 7
Feb. 26.	Flooring, etc.,	Worcester, Mass.	Feb. 7
	Advertised, Eng. News, Feb. 7 and 14.		
Feb. 26.	Laying water mains (16 sts.),	New York.	Feb. 14
Feb. 26.	Paving,	St. Louis Mo.	Feb. 14
Feb. 26.	Cement,	New York, N. Y.	Feb. 14
Feb. 26.	Iron bridges,	Auburn, Ind.	Feb. 14
Feb. 26.	Bridge,	Toronto, Ont.	Feb. 14
Feb. 26.	Wharf at	Burnt Church, N. B.	Feb. 14
Feb. 26.	Granite blk. pav'g,	Schenectady, N. Y.	Feb. 21
Feb. 26.	Asphalt paving,	Schenectady, N. Y.	Feb. 21
Feb. 26.	Water-works system,	Cumberland, Wis.	Feb. 21
Feb. 26.	Electric light plant,	Lynchburg, Va.	Feb. 21
Feb. 26.	Supplies for	Washington Navy Yard.	Feb. 21
Feb. 26.	Electric lighting,	Troy, N. Y.	Feb. 21
Feb. 26.	Iron and steel work,	Buffalo, N. Y.	Feb. 21
Feb. 27.	Removing dredge,	New York, N. Y.	Feb. 7
Feb. 27.	Sewers,	Cleveland, O.	Feb. 7
Feb. 27.	Water-works system,	Chesaning, Mich.	Feb. 21
Feb. 27.	Electric light plant,	Chesaning, Mich.	Feb. 21
Feb. 27.	Brick paving,	Louisville, Ky.	Feb. 21
Feb. 27.	Cast iron pipe,	Boston, Mass.	Feb. 21
Feb. 27.	Brick walks, etc.,	Kansas City, Mo.	Feb. 21
Feb. 28.	Breakwater repairs,	Duluth, Minn.	Jan. 31
Feb. 28.	Brick paving (5,700 sq. yds.),	Easton, Pa.	Feb. 7
	Advertised, Eng. News, Feb. 7 to 21.		
Feb. 28.	Electric lighting,	Urbana, O.	Feb. 7
Feb. 28.	Cedar blocks,	Fort Wayne, Ind.	Feb. 7
Feb. 28.	Stone, cement, etc.,	Duluth, Minn.	Feb. 7
Feb. 28.	Water-wks. system,	Port Clinton, O.	Feb. 7
	Advertised, Eng. News, Feb. 7.		
Feb. 28.	High school building,	Portage, Wis.	Feb. 14
Feb. 28.	Water-works system,	Canandaigua, N.Y.	Feb. 14
Feb. 28.	Grading,	New York, N. Y.	Feb. 21
Feb. 28.	Sewer,	New York, N. Y.	Feb. 21
Feb. 28.	Test wells,	Lebanon, O.	Feb. 21
Feb. 28.	Pipe work,	Lorain, O.	Feb. 21
Feb. 28.	Water-works system,	Vevay, Ind.	Feb. 21
Feb. 28.	Pipe sewers,	Erie, Pa.	Feb. 21
Feb. 28.	Granite flagging,	Boston, Mass.	Feb. 21
Feb. 28.	Sewer supplies,	Boston, Mass.	Feb. 21
Mar. 1.	Electrical subways,	Baltimore, Md.	Feb. 7
Mar. 1.	Removing shoals,	Detroit, Mich.	Feb. 7
Mar. 1.	Flagging (23 contracts),	Brooklyn.	Feb. 21
Mar. 1.	Water-works system,	Coleman, Tex.	Feb. 21
Mar. 1.	Hydrants,	Cleveland, O.	Feb. 21
Mar. 1.	Canal excavation,	Butte, Mont.	Feb. 21
Mar. 1.	Retaining wall,	Paterson, N. Y.	Feb. 21
Mar. 1.	Water-works system,	Fort Plain, N. Y.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 1.	Garbage disposal,	Pittsburg, Pa.	Feb. 21
Mar. 1.	Road bonds ($20,000),	Paterson, N. J.	Feb. 21
Mar. 2.	Pump and boilers,	Willimantic, Conn.	Feb. 7
	Advertised, Eng. News, Jan. 31 to Feb. 21.		
Mar. 2.	Bridge,	Halstead, Kan.	Feb. 21
Mar. 4.	Water-works system,	Credo, W. Va.	Feb. 14
Mar. 4.	Artesian well bonds,	Abbeville, Ga.	Feb. 14
Mar. 4.	Pile dike,	Duluth, Minn.	Feb. 14
Mar. 4.	Court house work,	Bakersfield, Cal.	Feb. 14
Mar. 4.	Electric lighting,	Atlantic City, N. J.	Feb. 21
Mar. 4.	Paving sidewalks,	Houston, Tex.	Feb. 21
Mar. 4.	Iron foot bridges,	Paterson, N. J.	Feb. 21
Mar. 4.	Plans for court house,	Decatur, Tex.	Feb. 21
Mar. 4.	Exhibition buildings,	Regina, N. W. T.	Feb. 21
Mar. 5.	Electric lighting,	Murfreesboro, Tenn.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 5.	Gravel paving,	Terre Haute, Ind.	Feb. 21
Mar. 5.	Electric lighting,	Menasha, Wis.	Feb. 21
Mar. 5.	Boiler & eng'e,	Tompkinsville, N. Y.	Feb. 21
	Advertised Eng. News, Feb. 21 and 28.		
Mar. 5.	Levee work (227,000 yds.),	Shreveport.	Feb. 21
Mar. 5.	Brick paving,	Louisville, Ky.	Feb. 21
Mar. 6.	Water-wks. system,	Ashland, O.	Feb. 7
	Advertised, Eng. News, Feb. 7 to 21.		
Mar. 6.	Pile bridges,	Plattsmouth, Neb.	Feb. 7
Mar. 6.	Brick paving,	Sandusky, O.	Feb. 14
Mar. 6.	Sewers,	Cleveland, O.	Feb. 21
Mar. 7.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 7.	Paving (10 streets),	Cleveland, O.	Feb. 14
Mar. 7.	Gravel road,	Bloomfield, Ind.	Feb. 21
Mar. 7.	County clerk's office,	Oswego, N. Y.	Feb. 21
Mar. 8.	Highway bonds ($100,000),	Athens, O.	Feb. 14
Mar. 9.	Water-works system,	Clinton, Ky.	Feb. 21
Mar. 11.	Water-wks. system,	Knoxville, Ill.	Feb. 7
	Advertised, Eng. News, Feb. 7 to March 7.		
Mar. 11.	Dredg'g and remov'g ledge,	Portland, Me.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 7.		
Mar. 11.	Water bonds,	Lafayette, Ind.	Feb. 14
Mar. 11.	Court house,	St. Joseph, Mich.	Feb. 14
Mar. 11.	Brick paving,	Monroe, Mich.	Feb. 21
Mar. 12.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 12.	Brick paving,	Peoria, Ill.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 12.	Pumping engine,	Dallas, Tex.	Feb. 21
	Advertised Eng. News, Feb. 21 to March 7.		
Mar. 12.	Sewers,	Peoria, Ill.	Feb. 21
Mar. 12.	Cast-iron pipe,	Toledo, O.	Feb. 21
Mar. 12.	Heating and vent'g app's,	Toledo, O.	Feb. 21
Mar. 13.	Boilers (18),	Cincinnati, O.	Feb. 21
Mar. 13.	Approaches at	Martinsburg, W. Va.	Feb. 21
	Advertised Eng. News, Feb. 21 and 28.		
Mar. 14.	Masonry culvert,	South Bend, Ind.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 14.	Improving streets,	Marion, O.	Feb. 21
Mar. 15.	Sewers (7 miles),	Bristol, Conn.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Feb. 28.		
Mar. 15.	Water-works system,	Port Hope, Ont.	Feb. 14
Mar. 15.	Pipe sewers,	Hamilton, O.	Feb. 21
Mar. 16.	Water-works system,	Evanston, O.	Feb. 21
Mar. 16.	Water bonds,	Evanston, O.	Feb. 21
Mar. 16.	Stone chapel,	Lancaster, O.	Feb. 21
Mar. 18.	Steel bridge,	Atlanta, Ga.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 18.	Pumping engines,	Sacramento, Cal.	Feb. 21
Mar. 19.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 19.	Iron fence, etc.,	Riverside, O.	Feb. 21
Mar. 19.	Electric lighting,	Whitewater, Wis.	Feb. 14
Mar. 21.	Electric lighting,	Meridian, Miss.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 14.		
Mar. 20.	Subway,	Boston, Mass.	Feb. 21
	Advertised in Eng. News, Feb. 21 to Mar. 7.		
Mar. 20.	Power house, etc.,	Toledo, O.	Feb. 21
Mar. 20.	Dredging & rem'g rock,	Newport, R. I.	Feb. 21
	Advertised, Eng. News, Feb. 21 to Mar. 14.		
Mar. 20.	Paving (10 streets),	Cleveland.	Feb. 21
Mar. 21.	Gravel roads,	Anderson, Ind.	Feb. 21
Mar. 23.	Dredging,	Montgomery, Ala.	Feb. 21
	Advertised Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Cement,	Montgomery, Ala.	Feb. 21
	Advert'sed, Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Canal (6½ miles)	Ottawa, Ont.	Feb. 21
Mar. 27.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 27.	Smokestack, etc.,	Toledo, O.	Feb. 21
Mar. 29.	Bridge bonds,	Winnipeg, Man.	Feb. 21
Apr. 1.	Brick paving (20,000 yds.),	Newark, O.	Feb. 21
May 15.	Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		
No date.	Electric lighting,	Tecumseh, Mich.	Feb. 21
"	Water-works system,	Salem, W. Va.	Feb. 21
"	Telegraph wire,	Wichita Falls, Tex.	Feb. 21

RAILWAYS.

East of Chicago.

AKRON, BEDFORD & CLEVELAND.—It is reported that the construction of this railway will be pushed as soon as the weather will permit. Pres., H. A. Everett; Secy., L. E. Bellstein; Gen. Man., Will Christy, 616 Garfield Bldg., Cleveland, O.

LANCASTER, CECIL & SOUTHERN.—The new directors of this company met at Elkton, Md., Feb. 15 and agreed to take steps to complete the road at an early date. W. M. Franklin, Jacob Long and J. W. B. Ranseman, of Lancaster, Pa.; J. E. Ramsey, A. M. Nevin and J. M. Showalter, of Oxford, Pa., and W. T. Warburton, of Elkton, Md., are directors.

OTTAWA, ARNPRIOR & PARRY SOUND.—Press reports state that contracts for the construction of the two ten-mile sections west of Long Lake were awarded last week. The successful bidder for the first 10 miles was Mr. Fanquier, of Toronto, who has already shared largely in the construction of the road, and for the second 10 miles, O'Neil & Ferguson. The work of construction is to commence early in the spring.

UNION TANNING CO.—The Sullivan, Pa., "Review" states that it is rumored that the Union Tanning Co. will build a railway from Laporte down Mill Creek to Cooper's Retreat, and thence down the Big Loyalsock to Hillsgrove, to haul lumber and bark.

Southern.

CHESTATEE PYRITES CO.—This company has been organized at Atlanta, Ga., and it is stated that surveys have been made for a railway from Lula to Dahlonega, Ga., directly through the company's property. Pres., George J. Baldwin, Savannah; Secy., N. P. Pratt; Treas., C. M. Chandler.

DOUGLAS & McDONALD.—It is reported that this road is to be built at once from Douglas, Ga., south to a point on the Brunswick & Western at McDonald, about 18 miles. The iron will be purchased at once and it is expected to have the road completed in 90 days.

ELIZABETHTOWN, CHADBOURN & ABBOTTSBURG.—A bill has been introduced in the North Carolina legislature incorporating this company.

FERNANDINA & WESTERN.—A press report from Fernandina, Fla., states that this company has been organized to construct a railway from Valdosta, Ga., to Fernandina, Fla.; capital stock, $500,000. This originated in a citizens' movement, through the Fernandina Chamber of Commerce, and has the strong personal backing of Col. H. R. Duval, Pres. Florida Central & Peninsular Ry. The road will run in almost an air line directly west from Fernandina to Valdosta, a distance of 110 miles. All the lumber and turpentine concerns along the route will take stock, and one lumber manufacturer has offered to donate 40 miles of track, now in operation from the pine forests to his mills on the St. Mary's River. Mrs. Lucy Carnegie, of Pittsburg, Pa., has offered to donate the iron for several miles of track. Work will begin at once and the road will probably be in operation before the opening of the Cotton States & International Exposition.

WEST VIRGINIA SHORT LINE.—This company is reported to have been incorporated to build a railway from New Martinsville, W. Va., following the valley of Fishing Creek to its headwaters, thence down the valleys of Middle Run and Ten-Mile Creek to the headwaters of the West Fork River, and following the valley of that stream to Clarksburg, W. Va.; capital stock, $1,000,000, with $5,000 paid in. Principal office, Clarksburg, W. Va.

Northwest.

BRAINERD & NORTHERN MINNESOTA.—Minnesota papers state that this railway is to be extended northwesterly 20 miles from its present terminus.

DULUTH & IRON RANGE.—This company is reported as receiving bids for building an additional extension of its road in the Mesabe range. Ch. Engr., R. Angst, Duluth, Minn.

MINNEAPOLIS, ST. PAUL & ASHLAND.—Incorporated in Wisconsin Feb. 14 to build a railway from Minneapolis to Ashland, a distance of about 200 miles; capital stock, $2,500,000; incorporators, Thos. Bardon, Edwin Ellis, D. W. Mowatt, and others. This project was noted in our issue of Jan. 31.

MISSISSIPPI, COLESBURG & MANCHESTER.—Organized to build a branch railway from Colesburg, Ia., to Turkey River station, Manchester, Dyersville, Onieda or any railway station located on any of the main lines contiguous to Colesburg; capital stock, $200,000; Pres. E. L. McNamee; Vice-Pres., R. O. Currie; Secy., W. C. Kirchheck; Treas., A. W. Rea; Gen. Man., F. A. Grimes. Considerable stock has already been subscribed, and work will be commenced as soon as spring opens.

Southwest.

HUTCHINSON & SOUTHERN IMPROVEMENT CO.—Incorporated in Kansas Feb. 15 to build and operate railway terminals; capital stock, $50,000; incorporators, L. A. Bigger, W. Whiteside, E. E. Hutchinson, B. W. Ladd and Chas. Collins, all of Hutchinson, Kan.

LEAVENWORTH & WESTERN.—Incorporated in Kansas to build a railway from Leavenworth to Topeka; capital stock, $100,000; incorporators, E. W. Snyder, W. R. Nickels, J. H. Wendorff, E. A. Kelly and Wm. C. Hook, all of Leavenworth, Kan.

VINING & COLEMAN.—Incorporated in Texas Feb. 11 to build a railway along the Colorado River from Coleman, Tex., to Waldrup, in McCulloch county; capital stock, $300,000; incorporators, W. N. Coler, Jr., of New York, and John D. McCall, W. R. Hamby, F. A. Taylor, J. W. Martin, E. A. Lindsay, J. E. McCord, C. M. Alexander, and W. R. Hockweather, of Texas; principal office at Coleman.

Rocky Mt. & Pacific.

SAN FRANCISCO & SAN JOAQUIN.—The citizens' committee of San Francisco has prepared articles for the incorporation of this company, noted Feb. 7, to build a railway from the San Francisco Bay, 350 miles southeast to Bakersfield, Kearn county, with a capital stock of $6,000,000 and the following directors: Claus Spreckels, J. D. Spreckels, W. F. Whittier, J. B. Stetson, Antoine Boriel, A. H. Payson, Charles Holbrook, Lewis Gerstle, Alvina Hayward, Isaac Upham, Thomas Magee. The popular subscriptions now exceed $2,130,000.

SANTA CLARA VALLEY.—Incorporated in California Feb. 11 with a capital stock of $300,000, of which $16,000 is paid in; incorporators, Francis Smith, Lewis A. Sage, W. P. Henley, H. R. Sterne, and W. O. Watson, all of Santa Clara county, Cal.

STREET AND ELECTRIC RAILWAYS.

NORWAY, ME.—The Norway & Paris St. Ry. Co. has been incorporated to build an electric railway 2½ miles in length; capital stock, $10,000; incorporators, Geo. L. Beal, Norway; Geo. E. Macomber, Augusta; and H. L. Shepherd, Rockland.

PORTLAND, ME.—The Portland R. R. Co. has been granted permission to equip its line with electricity. Gen. Man., E. A. Newman.

BOSTON, MASS.—Bids are asked until March 20 for constructing section 1 of the subway, as stated in our advertising columns. Ch. Engr., H. A. Carson; B. Leighton Beal, Secy. Comm.

BOSTON, MASS.—The Metropolitan Elevated Ry. Co. has petitioned for a charter; capital stock, $15,000,000, with authority to increase to $25,000,000. J. H. Bickford, Electrical Engr. is interested.——G. C. Gorham, H. C. Andrews, of New York, and Otis Kimball, of Boston, have petitioned for a charter for an electric railway company in the west end.

HOLYOKE, MASS.—The Holyoke St. Ry. Co. is having plans prepared by Clough & Reid for a brick power house, 1½ stories high, with heavy foundations. The building will accommodate enough engines to operate the entire plant, including the new Springfield branch. It is estimated that the building will cost about $120,000, including fixtures. The contract for the brick work has been awarded to Daniel O'Connell's Sons. It is reported that the capital stock of the company will be increased from $250,000 to $575,000, as other improvements are to be made.

HULL, MASS.—The Nantasket Electric St. Ry. Co. has been incorporated to build a road 4½ miles in length; capital stock, $12,500. Treas., Z. T. Harrington; Clk., G. F. McKay, 42 Court St., Boston; directors, J. L. Mitchell, G. E. David, Wm. F. Taylor and Benj. F. Durgin, of Hull.

NEWTON, MASS.—The car house of the Newton & Boston St. Ry. Co., on Walnut St., was destroyed by fire, together with 11 cars and a large quantity of electrical equipment, on Feb. 13; loss, about $30,000. The car house was built about three years ago at a cost of $12,000. The company is reported as to rebuild at once.

NORTH ATTLEBORO, MASS.—Edward R. Price has petitioned the selectmen for an electric railway franchise for a company reported to have a capital stock of $500,000.

MERIDEN, CONN.—The Southington & Plantsville Tramway Co. will probably extend its electric road to this city in the spring. L. V. Walkley is interested.

LONG ISLAND CITY, N. Y.—The Long Island City & Newtown R. R. Co. and the Steinway R. R. Co. have petitioned for permission to extend their electric roads. The latter company is reported as to spend $300,000 for improvements.

NEW BRIGHTON, N. Y.—The supervisors have granted franchises to the Staten Island Electric Ry. Co. and the Staten Island Interior Co. The injunction issued last week restraining the granting of the franchises has been modified.

TROY, N. Y.—The Troy & Albany Electric R. R. Co. is to extend its road to Cohoes in the spring, according to reports.

HACKENSACK, N. J.—The Highland Improvement Co. has been incorporated with a capital stock of $150,000. Press reports state that the object of the new organization is to acquire land at Fort Lee. The list of stockholders is the same as that of the Bergen County Traction Co. and the West Shore Electric Light Co., both recently incorporated. It is generally believed that this company has been formed for the purpose of acquiring the right of way all over Bergen county for the proposed electric system of the Bergen County Traction Co., so as to prevent other companies from getting ahead of it. Work on the trolley system, it is said, will begin in the spring.

LONG BRANCH, N. J.—Press reports state that the West End & Long Branch R. R. has been purchased by J. C. Shaffer, Pres. Seashore Electric Ry. Co., at Asbury Park. During the summer the road will run between Asbury Park and Pleasure Bay, connecting at Long Branch with the steamboat lines running to New York It is proposed to extend the road to Point Pleasant.

NEWARK, N. J.—The Consolidated Traction Co. has been granted permission to extend its electric railway to Bloomfield, estimated to cost between $100,000 and $200,000, and from Miller St. to the Union county line.——The North Jersey St. Ry Co. has petitioned for a franchise to Montclair, Verona and Caldwell.

PATERSON, N. J.—It is reported that the North Hudson County Ry. Co. has made a survey from the hill at Weehawken to the West Shore ferry for a proposed extension of its electric road. It is said that as soon as this extension is made the elevators and viaduct which now take passengers from the ferry to the road on the Palisades will be taken down. These elevators are the largest in the world, and are reported to have cost about $500,000. Ch. Engr., C. B. Brush.

PHILADELPHIA, PA.—The People's Traction Co. has awarded a contract for a car house at Willow Grove, with a capacity of 250 cars, and a large power house at Ogontz to operate the old York road and Willow Grove Branch.——The highway supervisors have granted permission to the Philadelphia & Westchester Turnpike Co. and the Delaware County Passenger Ry. Co. to construct tracks on Market St. from 40th St. to the county line.——Press reports state that the Pennsylvania R. R. Co. is about to award a contract for equipping the Burlington branch of the Amboy division with the trolley system. This division connects Burlington and Mount Holly, N. J., and is between seven and eight miles long. Should the experiment prove successful, other branches of the Pennsylvania R. R. will be operated by electricity instead of steam. The change of motive power will not prevent the use of steam locomotives on the branch, which will probably be used as at present for hauling freight.

ROCHESTER, PA.—It is reported that the People's Electric St. Ry. Co. will extend its line in the spring from Freedom for a distance of 10 miles.

WEST CHESTER, PA.—The West Chester & Downingtown St. Ry. Co. has been incorporated with a capital stock of $100,000. Pres., James McGraw.

OCEAN CITY, MD.—It is reported that the Sinepuxent Beach Co., Equitable Bldg., Baltimore, is about to ask for bids for constructing a standard gage electric railway six miles in length. Pres., Charles Goldsborough.

WASHINGTON, D. C.—A press report states that the district commissioners have granted a permit to the Eckington & Soldiers' Home R. R. Co. to equip four miles of its line with the underground electric system owned and controlled by the Electro-Magnetic Traction Co., of which organization Senator Stewart is president, and Senator Hunton, vice-president. The contract covers the installation of the system from the junction of North Capitol St. and New York Ave. south to G St., thence west along the latter thoroughfare to the Riggs House.

NORFOLK, VA.—The South Norfolk R. R. Co. has been organized to build an electric railway to connect the Norfolk City Ry. with South Norfolk. Pres., J. P. A. Mottle; Vice-Pres., C. A. Woodward; Secy. and Treas., P. L. Poindexter.

CHARLESTON, W. VA.—The West Charleston St. Ry. Co. has been incorporated to build a road from Kanawha, two miles, to Wilson's Hollow, three miles. Incorporators, Prof. George S. Laidley, city superintendent of schools; Malcom Jackson, Geo. S. Couch, F. P. Grosscup, Pres. Buckeye Cart Co., and J. W. Raike.

FAIRMONT, W. VA.—Press reports state that a movement is on foot at this place to build an electric railway from Fairmont to Riversville, by way of West Fairmont, Monongah, and Barnsville. The road is to cost about $100,000 and will be 15 miles in length.

ORLANDO, FLA.—The council is discussing an ordinance granting a franchise for an electric railway.

BILOXI, MISS.—The following are the officers of the Gulf Coast Electric R. R. Co., recently incorporated with a capital stock of $500,000: Pres., A. M. Dahlgren; Gen. Man., J. B. Cable; Secy., J. V. Ross.——It is reported that E. G. Burklin has been granted a 50-year franchise for an electric railway to cover nearly all the principal streets of the town and from Point Cadet to the lighthouse.

DETROIT, MICH.—The Detroit & Mount Clemens Electric Ry. Co., which was organized about a year ago with a capital stock of $250,000, is soon to perfect its organization and adopt definite plans for the construction of its road. It is reported that work will begin as soon as possible, and it is expected that the line will be in operation by April 15. About 15 miles of track will be laid at an estimated cost of about $16,000 per mile. C. J. Reilly and C. M. Swift are interested.——It is reported that the Detroit Ry. Co. has awarded a contract for four boilers of 500 HP. each to the Sterling Co., of Chicago. Pres., Albert Peck.

PAW PAW, MICH.—The council is considering a proposition presented by D. F. Glidden, of Detroit, for an electric railway between this place and Lawton. The town has voted to subscribe $15,000 to aid in its construction. R. J. Cunningham is interested.

CINCINNATI, O.—Press reports state that the board of administration has issued an order which, if carried out literally, will wipe out of existence about $600,000 worth of property. It directs the Cincinnati Inclined Plane Ry. Co. to remove from the streets its tracks within one month, and the inclined plane within two months, except such portions of the track as are composed of full girder rail. This action is based on a judgment of the superior court, that the franchise of this company has expired by limitation, and the company has declined to accept the terms offered for a renewal of the franchise.

CHICAGO, ILL.—The Columbian Construction Co. has awarded a contract to the Union Bridge Co., of New York, for the construction of the iron work of the Northwestern Elevated R. R. at about $1,500,000. The Union Bridge Co. has sublet a portion of the contract to the Elmira Bridge Co., of New York. The Columbian Construction Co. has the contract for the complete building of the road, and it is through that company that all the work is being done. The contracts call for a four-track structure from the intersection of Wilson and Evanston Aves., which is the present northern terminus of the road, to Chicago Ave., and a two-track structure from Chicago Ave. to a connection with the Lake St. terminal. It is reported that the road will be in operation by January, 1897.

EAST ST. LOUIS, ILL.—The East St. Louis Electric St. Ry. Co. has voted to extend its line through the stock yards. Vice-Pres., H. D. Saxton.

FORT WORTH, TEX.—The Fort Worth St. R. R. Co. has increased its capital stock from $100,000 to $200,000.

DENVER, COLO.—The Denver Consolidated Tramway Co. has been granted permission to extend its electric railway on several streets. Gen. Supt., C. R. Durbin.

TACOMA, WASH.—An ordinance has been introduced in the council granting a franchise for the long-talked-of electric railway between this city and Seattle, according to reports.

ELECTRIC LIGHT AND POWER.

NORTHFIELD, VT.—A town meeting will be held Feb. 26 to discuss the question of establishing an electric light plant to be owned by the town. F. L. Howe, Village Clk.

READSBORO, VT.—The Hoosac Electric Power & Mfg. Co., recently incorporated, with a capital stock of $100,000, intends to transmit about 2,000 HP. from Howes Pond to North Adams, Mass., and other places within a distance of 10 miles. About 10,000 ft. of 24 to 18-in. iron pipe will be needed. W. S. Kelly, of the General Electric Co., of Boston; C. Q. Richmond, and ..

S. Proctor Thayer, of Boston and Elmer J. Bullock, of Readsboro, are interested.

TROY, N. Y.—Bids are asked until Feb. 26 for lighting the city with 350 arc lights of 2,000 c. p. for one year from March 1, 1895, and also for two years from March 1, 1896; parties bidding for last two years not having plant in operation to give bond of $15,000 to guarantee the erection of plant by March 1, 1896. The lights are now costing the city $144.17 each per year under a five-year contract, which expires March 1, 1895. M. R. Sherrerd, Cy. Engr.

ATLANTIC CITY, N. J.—Bids are asked until March 4 for lighting the streets with 151 arc lights and 150 infor lighting the streets with 151 arc lights and 150 incandescent lights for one to five years. E. D. Irelan, Cy. Clk.

ALTOONA, PA.—The council is reported as to submit the question of issuing $120,000 in bonds for a municipal electric light plant to a popular vote.

BELLEVUE, PA.—The Bellevue Electric Light Co. has been granted a franchise.

PHOENIXVILLE, PA.—The Schuylkill Valley Illuminating Co. has purchased the buildings it now occupies on Vanderslice St., together with the needle factory of Knowles Croskey, with the object of enlarging its plant.

LYNCHBURG, VA.—Bids are asked by the city treasurer until Feb. 26 for constructing and equipping a municipal electric light plant with a capacity of 201 arc lights. David E. Evans & Co., of Harrison St., Baltimore, Md.

FAYETTEVILLE, N. C.—It is reported that bids will soon be asked for putting in an electric plant, estimated to cost $10,000, including a 50-HP. engine and 2,000 incandescent lights.

FLORENCE, S. C.—It is reported that the plant of the electric light company was destroyed by fire Feb. 12; loss, $25,000.

ATLANTA, GA.—The Atlanta Electric Power Co. has made surveys for developing 30,000 HP. nine miles from this city on the Chattahoochee River, and 15,000 HP. at a point on the same river 13 miles distant, and it is stated that work on the dams, etc., will begin as soon as possible. Engr., J. H. Vail, 39 Cortlandt St., New York.

BARTOW, FLA.—The granting of a franchise for an electric light plant is being discussed.

ORLANDO, FLA.—The council is considering an ordinance granting a franchise for an electric light plant.

MURFREESBORO, TENN.—Bids are asked by the committee until March 5 for lighting the streets with arc and incandescent lights for 5 or 10 years, as stated in our advertising columns.

CLEVELAND, O.—The mayor has been securing estimates for an electric plant for lighting the city buildings, estimated to cost $19,755.

TOLEDO, O.—Bids are asked until March 20 for constructing power house to be connected with the court house by a tunnel. Arch., D. L. Stine; Chas. A. Jones, County Audr.

GREENFIELD, IND.—Press reports state that the electric light plant has been sold to a company that will enlarge the plant.

MUNCIE, IND.—Press reports state that at Winchester, just east of Muncie, on Feb. 15 natural gas exploded, wrecking the city electric light plant, and the debris then burned. Oliver Eller, of Muncie, who was superintendent, is believed to be fatally injured. The plant was nearly a total loss.

BERRIEN SPRINGS, MICH.—The Berrien Springs Water Power Co. is reported as receiving estimates and plans for a dam across the St. Joseph River, to be 450 ft. in length and 16 ft. high. The company is also prepared to negotiate with capitalists. Secy., F. McOmber.

CHESANING, MICH.—Bids are asked until Feb. 27 for the construction of an electric light plant. J. B. Morehouse, Cy. Clk.

STANTON, MICH.—Press reports state that the council has voted to submit to the people at the coming election the question of bonding the city for $6,000 for the purpose of putting in an electric light plant to be owned and operated by the city.

TECUMSEH, MICH.—Bids are asked for furnishing from 35 to 40 double arc lights of 2,000 c.p. for five years. W. J. Ingersoll, Clk.

GREENVILLE, ILL.—It is reported that the council has awarded a contract to a St. Louis firm for lighting this place by electricity, work on the plant to be begun at once.

ARCOLA, ILL.—It is reported that an electric light plant is to be put in at this place.

MENASHA, WIS.—Bids are asked until March 5 for lighting the city with 50 arc and a number of incandescent lights. W. W. Reed, Cy. Engr.

KANSAS CITY, MO.—The Kansas City Electric Light Co. has increased its capital stock from $300,000 to $450,000.

WEBB CITY, MO.—Bids are asked by the city clerk until Feb. 25 for the purchase of $15,000 of 20 year bonds for an electric light plant.

VICTOR, COLO.—Press reports state that a new light and power company has been organized by James A. Doyle, of the Portland Mining Co.; capital stock, $50,000. The plant is to be erected at the south end of Fourth St.

RIVERSIDE, CAL.—The council is considering a proposition of the Fort Wayne Electric Co. to put in an electric light plant of 40 arc and 1,000 incandescent lights for about $16,000, or $30,000 for a larger plant. James W. Johnson, Cy. Engr.

NEW COMPANIES.—The Wellsville Electric Light Co., Wellsville, O.; R. L. Andrews, Homer Laughlin.

Fuller Electric Engineering Co., East St. Louis, Ill.; $30,000; W. A. Fuller, Chas. T. Dana, C. H. Dudley.

Pennsylvania Heat, Light & Power Co., Philadelphia, Pa.; $10,000, with $1,000 paid in; Pres., Robert Reaves, Scranton, Pa.

Suburban Gas & Electric Co., Revere, Mass.; $75,000; Pres., Arthur Perry; Treas., Wm. H. Whitney; Allston Burr, Boston.

Siloam Springs Improvement Co., Siloam Springs, Ark.; $100,000; to establish an electric light plant, etc.; E. T. Wisner, R. S. Morris, Z. T. Conley, E. P. Watson.

Universal Heating, Lighting & Power Co., Hoboken, N. J.; $10,000, with $2,000 paid in; Wm. C. Baker, Franklin G. Colby, Alpine, N. J.; Mary A. Dean, Brooklyn, N. Y.

Pacific Storage Battery Co., San Francisco, Cal.; $20,000, with full amount paid in; to manufacture storage batteries, dynamos, and electrical equipments; Thos. Addison, Berkeley; Robt. B. Elder, San Francisco; Fred. F. Barbour, Oakland.

BRIDGES.

SOLON, ME.—The county commissioners have petitioned for aid to build a bridge over the Kennebec River, near this town.

BOSTON, MASS.—The committee on finance is reported as considering an appropriation of $28,500 for a bridge over Chelsea Creek from Breed's Island to Chelsea.

NEW HAVEN, CONN.—The residents of Fair Haven have petitioned for a new drawbridge over the Quinnipiac River on Grand Ave.

ROCHESTER, N. Y.—The contract for the substructure of the new lift bridge at Emerson St. has been awarded to B. P. Smith, Rochester, at $3,753, and that for the superstructure to the Wrought Iron Bridge Co., Canton, O., at $9,940.——A bill has been introduced in the legislature appropriating $50,000 for a bridge over the Erie Canal at Exchange St., in this city.

SYRACUSE, N. Y.—The legislature has passed a bill appropriating $15,000 for a bridge over the canal at Salina St., in this city.

ELIZABETH, N. J.—A bill has passed both branches of Congress, authorizing the construction of a bridge across Newark Bay, between Hudson and Union counties.

PATERSON, N. J.—Bids are asked until March 4 for two iron foot bridges to cross the Morris Canal in this city. J. H. Burke, Chn. Freeholders.——Efforts are being made to secure the construction of the proposed Bramhall bridge to Totowa, at a cost of $25,000.

MONONGAHELA, PA.—A bill has been introduced in the House authorizing the Pittsburg, Monongahela & Wheeling Ry. Co. to construct a bridge across the Monongahela River at this place.

PITTSBURG, PA.—It is proposed to erect several new bridges, including a stone bridge over the ravine at a cost of about $170,000, out of the bonds voted Feb. 19.

CUMMING, GA.—Efforts are being made to secure a bridge across the Chattahoochee River by the residents of this place.

NEW ORLEANS, LA.—Specifications have been adopted for an iron bridge across the canal at Galvez St.

LOVELAND, O.—The council has directed the engineer to prepare plans for a foot bridge over the creek.

CHICAGO, ILL.—D. H. Burnham & Co. have been awarded the contract for preparing plans for a bridge with a 60-ft. driveway and 15-ft. walks, by the South Park commissioners, at 1½% of the cost of the bridge.

MURPHYSBORO, ILL.—The citizens have voted $5,000 for an iron bridge to Carbondale, according to reports.

MILWAUKEE, WIS.—Bids are asked until Feb. 23 for a new turntable drum for Oneida St. bridge. G. M. Benzenberg, Cy. Engr.

DAVENPORT, IA.—The Davenport & Rock Island Construction Co. has been incorporated to construct a bridge across the Mississippi River at this place; capital stock, $500,000; Pres., Marcus Johnson; Vice-Pres., Frank P. Blair; Secy. and Treas., N. F. Shovert.

ST. PAUL, MINN.—The Northern Pacific R. R. Co. is reported about to build an $80,000 steel bridge across the Flathead River in the Rocky Mountains. Gen. Man., I. W. Kendrick.——A large number of bridge bills has been introduced in the legislature, including the following: Appropriating $4,000 for a wagon bridge across the Mississippi River in Stearns county; $5,000 for a similar bridge at Elk River; $8,000 toward one at Aitkin; $8,000 toward an iron bridge across the Rum River, and $15,000 for a bridge across the Zumbro River in Olmstead county.

WEST DULUTH, MINN.—The St. Paul & Duluth Ry. Co. is reported as about to make bridge improvements to cost $30,000, the work including 1,500 ft. or more of new bridge on each side of the draw.

HALSTEAD, KAN.—Bids are asked until March 2 for the construction of a bridge over the Little Arkansas River on township line between Halstead and Lakin townships near this city. D. W. Thompson, Trustee.

MANKATO, KAN.—The county commissioners have petitioned for authority to make an appropriation for a bridge across the Republican River.

CHEYENNE, WYO.—A correspondent writes us that the county commissioners are talking of building an iron or steel bridge across the North Platte River, near Hartville. It will be 158 ft. long, one span, solid rock bank 30 ft. high on the north side and about 20 ft. high on south side. Walter D. Pease is county surveyor.

BRUNSWICK, MO.—Plans have been submitted for a county bridge across the river at this place to cost $12,000.

WINNIPEG, MAN.—Bids are asked until March 29 for the purchase of $40,000 of 30-year 4% bridge bonds. R. W. Jameson, Chn. Com.

BUILDINGS.

BUFFALO, N. Y.—Bids are asked until Feb. 26 for the iron and steel work required in the erection of 304 steel cells, steel cages, window guards, steel door frames and doors, steel trusses for roof and lantern, for the new addition of the Erie county penitentiary. Wm. M. Cummings, Chn. Com.——Local papers state that bids will be received until Feb. 25 for the erection of the Ellicott Square building, which is to surpass in many particulars any of the large buildings of Chicago. Arch., D. H. Burnham, Chicago. J. L. Williams, H. W. Sprague, Thos. T. Ramsdell, W. H. Hotchkiss and F. C. M. Lantz are among those in Buffalo reported as interested.——The board of public works will soon advertise for competitive designs for a $125,000 high school building.——The executive board of the General Hospital has selected Architect George Cary's plans for its new buildings, which will cost about $150,000.——Green & Wicks, Archs., are preparing plans for a six-story brick building to be built at 391 Main St. for George B. Mathews. It will cost about $50,000.

NEW YORK, N. Y.—Plans have been filed for the following five-story brick flats: By Hirsh & Steinhard, for 5 to cost $119,000 and 4 to cost $110,000; Matthew C. Kervan, 110 W. 127th St., 3 to cost $105,000; J. B. Smith, 13 to cost $208,000.

OSWEGO, N. Y.—Bids are asked until March 7 for the construction of the new county clerk's office. Arch., J. H. Seeber, Arcade Bldg.; Chn. Com., I. J. Rich, Arcade Bldg.

GREENBURG, PA.—The grand jury has recommended the erection of a new court house.

WEST CHESTER, PA.—Thos. P. Worrall, president of the gas company, has plans prepared for a new brick building, with iron roof and steel floor, to take the place of one recently burned, according to reports.

WILKES BARRE, PA.—The county commissioners have decided to build a $400,000 court house on the site of the present building, the contracts to be awarded as soon as possible.

COBHAM, VA.—Grace church, near this place, was recently burned. A press report states that it was one of the handsomest churches in the state. Plans for the rebuilding will be prepared at an early date. C. E. Dickinson, of Cobham, is interested.

MARTINSBURG, W. VA.—Bids are asked until March 13 for the approaches to the U. S. public building in this city, as stated in our advertising columns. Address Chas. E. Kemper, Acting Supervising Arch., Washington, D. C.

LANCASTER, O.—Bids are asked until March 16 for the erection of a stone chapel at the boys' industrial school. C. D. Hilles, Secy.

TOLEDO, O.—Bids are asked until March 12 for the steam heating, ventilating, and a hydraulic plant for the new court house, and until March 27 for the power house, tunnel and smoke stack. C. J. Jones, County Audr.

WABASH, IND.—It is reported that plans have been completed for rebuilding the Big Four shops at this place, at a cost of $95,000.

CHICAGO, ILL.—Bids are asked by the board of education, 109 Randolph St., until Feb. 25 for erecting a 9-room and a 21-room school building.

DECATUR, TEX.—Bids are asked until March 4 for plans and specifications for a $65,000 court house. R. F. Spencer, County Judge.

REGINA, N. W. T.—Bids are asked until March 4 for the erection of various territorial exhibition buildings at this place. R. B. Gordon, Clk. Executive Com.

WATER-WORKS.

BANGOR, ME.—The water board is discussing the purchase of a new 10,000,000-gallon pumping engine and a stand-pipe.

BOOTHBAY HARBOR, ME.—The town has appropriated $10,000 for extensions, which will be made in the spring.

BELLOWS FALLS, VT.—A correspondent writes us that it is proposed to replace small mains with larger, but that the question has not yet been decided. C. S. Morse is the official in charge.

BOSTON, MASS.—Bids are asked by the water board until Feb. 27 for a supply of 48 to 4-in. cast iron water pipe, three contracts.

HINGHAM, MASS.—The question of purchasing the works will come before the town meeting next month. The plant is said to be worth about $500,000.

PEPPERELL, MASS.—P. J. Kemp, Town Clk., writes us that $600 was appropriated for surveys and plans, which have been made; works are estimated to cost $100,000, and the question will be submitted at the annual town meeting March 18; proposed supply from wells; population, 3,500.

JEWETT CITY, CONN.—Wm. H. Tift, Town Clk., writes us that the contract for works has been awarded to the Jewett City Water Co.

CALEDONIA, N. Y.—The citizens are reported to have voted for works.

FORT PLAIN, N. Y.—Bids are asked until March 1 for constructing works, as stated in our advertising columns (postponement of date from Feb. 5). Harvey Wick, Secy. Comrs.

MIDDLETOWN, N. Y.—A correspondent writes us that the vote upon the proposition to raise $150,000 for extensions was lost by a vote of 312 to 144, and that no extensions will be made this year. C. H. Smith is city engineer.

MOUNT VERNON, N. Y.—The New York Suburban Water Co. is considering the construction of three miles of new mains and a small reservoir.

RED HOOK, N. Y.—D. W. Wilbur writes us that plans for the proposed works are not completed; estimated cost, $30,000; the work will be advertised about April 1

SARATOGA SPRINGS, N. Y.—There is talk of adopting the meter system. Geo. L. Corliss, Pres. Comrs.

TUCAHOE, N. Y.—H. M. Underhill, W. A. Cameron and others have applied for a franchise for the East Chester Water & Light Co. The town is asked to contract for 40 or 50 fire hydrants.

GLASSBORO, N. J.—It is reported that the proposed construction of works will be submitted to the people at the spring election.

MORRIS PLAINS, N. J.—W. K. Everitt, warden, writes us that the legislature is considering a bill authorizing an appropriation for an additional supply, but that the bill has not yet been passed.

PATERSON, N. J.—The advisability of municipal ownership of the works is being considered.

ALLEGHENY, PA.—At an election Feb. 19 the citizens voted in favor of issuing $1,406,000 in bonds, including $400,000 for water-works extensions.

BEAVER FALLS, PA.—The bids recently received for works are noted under Contract Prices. It is stated that the total contracts amount to $100,460, or nearly $10,000 less than when the contracts were awarded a short time ago. Engrs., James H. Harlow & Co., Pittsburg, Pa.

BELLEVUE, PA.—J. M. Shueral, Secy. Council,

writes us that the council is considering an ordinance granting a franchise for works.

BUTLER, PA.—The citizens are reported as dissatisfied with the present service and investigating the question of new works.

MEADVILLE, PA.—Isaac S. Cassin & Son, of Philadelphia, have reported to the Meadville Water Co. upon the present commercial value of its plant.

PITTSBURG, PA.—At an election Feb. 19 the city voted to issue $4,750,000 in bonds for improvements. This includes $2,000,000 for water-works extensions, as follows: Brilliant pumping station, eight 12,000,000-gallon pumping engines, with additional suction pipes and crib into river, $700,000 (less amount appropriated, $50,000); 10 additional boilers, $25,000; two boiler houses and smokestacks, $35,000; storehouse and machine shop, $5,000; reservoir, $714,288. Herron Hill station, grounds for new building, $10,000; new building, $25,000; two 5,000,000-gallon pumping engines, $50,000; two boilers and fittings, $4,000; feed-water and steam lines, $500; 30-in. supply line, $150,000; 20-in. force main to Bedford basin, $38,000; 24-in. rising main to Herron Hill basin, $6,500; new chamber at Herron Hill reservoir, $20,000. Garfield pumping station, two 1,500,000-gallon pumping engines, $10,000; 12-in. rising main, $4,500; one tank and foundation, $5,000. New pumping station, Lincoln Ave. district, $20,000; extensions, $227,212.

WILKES BARRE, PA.—The Citizens' Water Co. and the Consumers' Water Co. have petitioned for franchises. A committee, including the city engineer, George Johnson, Engr., and three councilmen, is investigating the merits of the two companies.

MIDDLETOWN, DEL.—The legislature has authorized this city to borrow $6,000 to complete the works.

NORFOLK, VA.—The council has appropriated $20,000 to secure an additional water supply from driven wells.

SALEM, W. VA.—Bids, including specifications, are asked for works, according to report, to consist of a stand-pipe, 20-HP. engine, 3,000 ft. of 4-in. mains, etc.

HICKORY, N. C.—E. B. Cline, Mayor, writes us that the proposed bond issue failed of ratification by the people.

GREENSBORO, N. C.—A. W. Scoles, Cy. Clk., writes us that it is not probable that the legislature will be petitioned for authority to issue additional water bonds; the city already has works.

MOUNT PLEASANT, N. C.—J. H. Schultze writes us that the report has not yet been completed.

JACKSONVILLE, FLA.—The council is discussing proposed new reservoirs and other improvements.

KEY WEST, FLA.—A correspondent writes us that William J. Dilworth, of Philadelphia, who is drilling the artesian well for the new works, is averaging 2½ ft. per hour through coral rock. The well is now 350 ft. deep.

BESSEMER, ALA.—G. H. Stevenson, Supt., writes us that the proposed new work is the piping of the present supply from its source to the reservoir. The city will purchase works upon the erection of steel plant.

MOBILE, ALA.—The city clerk writes us that the water works question will have to be submitted to a vote of the people, and that there is a prospect that the present proposition will be defeated. There are two private companies in the city at present.

NEW ORLEANS, LA.—The New Orleans Water Works Co. is awarding contracts for about 20 miles of extensions. For the work for which bids were opened Feb. 9 the following bids were received; Supt., L. H. Gardner:

Manion & Co., New Orleans (awarded contract)	$70,414
Branham, Gest & Co., Cincinnati	$78,890
Herbert Lapayre & Co., Chattanooga	87,820
New Orleans Railway & Mills Supply Co.	86,594

CLEVELAND, TENN.—An election will be held in May to vote on an issue of $43,000 in bonds to build works, according to reports.

FRANKLIN, TENN.—A bill has been introduced in the legislature authorizing an issue of $30,000 in bonds to build works.

CLINTON, KY.—Bids are asked by the town until March 9 for constructing works, according to reports.

COVINGTON, KY.—The trustees of Central Covington are discussing the question of an issue of $5,000 in bonds for works.

HOPKINSVILLE, KY.—Jesse W. Starr, Planter's Hotel, St. Louis, writes us that he will require for the new works at this place, compound duplex condensing engines, 100 hydrants, 10½ miles of 12 to 4-in. pipe; 18 × 100-ft. stand-pipe and two 100-HP. boilers; estimated cost of works, $100,000.

BARNESVILLE, O.—H. E. Dement, Cy. Clk., writes us that no steps have yet been taken to secure works.

CELINA, O.—J. P. Le Blond, Pres. Bd., writes us that Voorhees & Witmer, of Buffalo, N. Y., have been engaged to prepare plans for works. A. W. Fishpaugh, of Celina, will be the local engineer in charge of construction. Contracts will be awarded as soon as possible.

CINCINNATI, O.—Bids are asked until March 13 for 18 boilers; separate bids to be received for the equipping of each battery with mechanical stoker or smoke-preventing device. Supt., W. P. Tharp; A. P. Butterfield, Clk. Bd. of Administration.

CLEVELAND, O.—Bids are asked until March 1 for about 200 4-in. and 12 6-in. fire hydrants. J. H. Farley, Dir. Pub. Wks.

EVANSTON, O.—Bids are asked until March 16 for about 178 tons of pipe, with valves, hydrants, etc.; for pipelaying, etc.; also for the purchase of $10,000 in 6% water bonds. Engr., Chas. A. Ewing. Clk., W. H. Krapp.

LEBANON, O.—Bids are asked until Feb. 28 for drilling test wells. Bids for the construction of works will be received after a water supply has been obtained.

LOGAN, O.—A. V. Crawford writes us that the citizens have voted, 630 to 101, to issue $60,000 in bonds for water-works and sewers; no plans yet adopted.

LORAIN, O.—Bids are asked until Feb. 28 for pipe work connecting up two 150-HP. boilers with the water-works pumps, feeders, etc. F. C. Norcross, Supt.

MARTINS FERRY, O.—The water board has petitioned for a bond issue for a larger main to furnish water to Bridgeport.

ST. MARY, O.—The council is reported to have voted to put in works.

TOLEDO, O.—Bids are asked until March 12 for about 1,000 tons of 12 to 6-in. pipe. T. R. Cook, Supt.

INDIANAPOLIS, IND.—The Indianapolis Water Co. has awarded a contract for a 20,000,000-gallon pumping engine to the Snow Steam Pump Works, Buffalo. The engine will weigh 1,296,000 lbs. and cost $70,000.

PARIS, IND.—We are informed that no works are contemplated at present.

VEVAY, IND.—Bids are asked until Feb. 28 for the construction of works. Address F. C. Denmann, Cy. Clk., or A. H. Kennedy, Supt., Rockport, Ind.

CHESANING, MICH.—Bids are asked until Feb. 27 for the construction of works. J. B. Morehouse, Village Clk.

MUSKEGON HEIGHTS, MICH.—There is talk of constructing works, and it is reported probable that definite steps will soon be taken.

ONTONAGON, MICH.—A bill has been introduced in the legislature authorizing this village to borrow $12,000 for water-works extensions.

BLOOMINGTON, ILL.—Local papers state that there are 500 meters in use in the city, and efforts are being made to have this number increased.

ELGIN, ILL.—The commissioners have contracted with the Holly Mfg. Co. for a new 6,000,000-gallon pumping engine, to cost $21,000.

FARMER CITY, ILL.—Press reports continue to state that works to cost about $6,000 will be put in, but the city clerk writes us that the works have already been constructed.

MARSEILLES, ILL.—The Crystal Mineral Water Co., the incorporation of which was noted last week, is not yet ready to receive bids for constructing works. We are informed that the franchise provides for three miles of mains and 35 hydrants at $60 each per year; also 1,000,000-gallon pumping machinery and a 300,000-gallon reservoir. G. C. Stebbins is interested.

PARIS, ILL.—C. H. Hodge, Clk., writes us that no steps have yet been taken in regard to the proposed improvements.

MADISON, WIS.—John B. Helm, Supt., writes us that probably 1½ miles of new mains will be laid this year.

CUMBERLAND, WIS.—Bids are asked until Feb. 26 for constructing works. Engr., C. F. Loweth, St. Paul, Minn. S. W. Hines, Mayor.

DUNLAP, IA.—The contract for works has been awarded to the Fremont Machine & Foundry Co. The work will include a 10 × 55-ft. stand-pipe, with foundations, 3,460 ft. of 6-in. main, 60 ft. of 4-in. connections to hydrants, 5 hydrants, etc. The bids were as follows:

Fremont Foundry & Machine Co., Fremont, Neb.	$2,875
Challenge Wind & Feed Mill Co., Batavia, Ill.	3,074
Creilin & Lovell, Des Moines, Ia.	*3,160
Iowa Eng. & Constructing Co, Clinton, Ia.	3,156
U. S. Supply Co., Omaha, Neb.	3,270
Iowa Mfg. & Const'n Co., Sioux City, Ia.	3,989
Estimate of F. L. Burrell, Engr., Fremont, Neb.	3,635

* With steel tower and wooden tank in place of stand-pipe, $3,080.

FOREST CITY, IA.—J. A. Peters, Cy. Recdr., writes us that the contract for works, except stand-pipe, has been awarded to Crellin & Lovell, Des Moines, and the contract for a stand-pipe to the Chicago Bridge & Iron Co., the plant complete to cost $10,073. The total bids received will be published next week.

LIVERMORE, IA.—The council is reported as in favor of calling an election to vote on the question of works.

EXCELSIOR, MINN.—The city recorder writes us that no steps have yet been taken for works.

PLAINVIEW, MINN.—R. R. Damonde, Cy. Recdr., writes us that plans and specifications have been made by Fairbanks, Morse & Co., of St. Paul, Minn., and that an election was held Feb. 18 to vote on an issue of $15,000 in bonds; works will include three miles of 8 to 4-in. mains, a steel tower 80 ft. high, with a 65,000-gallon wooden tank and 35 hydrants; supply from artesian well.

COFFEYVILLE, KAN.—T. H. Brooks, Cy.Clk., writes us that no definite steps have yet been taken to secure the proposed improvements described in our issue of Jan. 3, but that decisive action will be taken this spring. Engrs., Tuttle & Pike, Kansas City, Mo.

INDEPENDENCE, KAN.—J. B. Underhill, Cy. Clk., writes us that a bill has been introduced in the legislature granting permission to the city to issue bonds to purchase the works owned by the Southern Kansas Water Co., the city having the right under the franchise to purchase the plant July 1, 1895. In case of purchase it is not probable that any extensions will be made at present.

HELENA, MONT.—A bill has been introduced in the legislature authorizing the city to increase its bonded indebtedness to secure water-works to be owned by the city.

NEVADA, MO.—The contract for an artesian well for a new supply is noted under Contract Prices.

SWEET SPRINGS, MO.—F. H. Tisdale, Cy. Clk., writes us that the proposition to issue bonds for works and an electric light plant has been defeated by eight votes, and that it is stated that a petition will be presented to the council at its next meeting asking for another election.

BELTON, TEX.—H. A. Wear, Supt., writes us that no improvements are contemplated at present.

COLEMAN, TEX.—Bids are asked until March 1 for the construction of works, which will include about four miles of 8 to 4-in. pipe, 20 hydrants, masonry reservoir, etc. Engr., J. S. Thatcher, Dallas. Cy. Clk., Joseph E. Brown.

DALLAS, TEX.—Bids are asked until March 12 for a 10,000,000-gallon pumping engine, as stated in our advertising columns. J. C. Woodside, Chn. Comrs.

McKINNEY, TEX.—R. F. Dowell, Cy. Secy., writes us that the commissioners have put in a large windmill and a tank for temporary use, and that it is expected that this summer the city will either put in complete works or grant a franchise; population, 5,000.

ENID, OKLA.—It is stated that works will soon be put in.

VICTOR, COLO.—The council has voted to issue $75,000 of water bonds. Mitchell Bros., of Pueblo, will take the bonds, and as soon as the pipe-line is surveyed the construction will be pushed.

BANNING, CAL.—The Banning Water Co. was incorporated Feb. 12 to operate in Los Angeles county; capital stock, $90,000, commencing with $1,240; incorporators, Charles W. Filkins and George W. Bryant, of Riverside; Wilson Hayes, of Banning; T. R. Hafer and Jacob Klein, of Carson City, Nev.

SACRAMENTO, CAL.—Bids are asked until March 18 for a 5,000,000 and a 10,000,000-gallon high-duty pumping engine, including air pumps, valves and other appurtenances; city to furnish concrete foundation and build pump house. B. U. Steinmans, Mayor, writes us that the improvements will cost about $50,000 and are to be paid for within one year. O. S. Flint, Cy. Clk.

ARNPRIOR, ONT.—It is reported that works will be constructed in the spring.

TORONTO, ONT.—The engineer has recommended that a 36-in. supply and force main be laid at an estimated cost of $135,500; also that 24 and 36-in. mains be laid at a cost of $40,000, and $22,000 worth of branches be constructed.

IRRIGATION.

NELIGH, NEB.—It is reported that the citizens have refused to vote bonds to aid in the construction of an irrigation and power canal, but it is believed that a private company will carry out the work. The company proposes to build a canal from a point 14 miles from Neligh and ending near town. It will take a sufficient amount of water from the Elkhorn River to irrigate the land along its course and also to furnish 900 HP. at the terminus.

CHEYENNE, WYO.—Press reports state that the state senate has passed the house bill providing for the acceptance and reclamation of the million acres of arid land donated the state under the provisions of the Carey bill. There is no question about the bill receiving the governor's approval. Several large construction companies are ready to enter into contracts with the state under the new law for the construction of large irrigation works along the large streams in the northern and central portions of Wyoming, where there are magnificent valleys of fertile agricultural lands.

PLAINVIEW, TEX.—A press report from this city states as follows: The White River Land & Irrigation Co. has been chartered to put in a system of irrigation along White River draw. This company will secure its water from the underflow. All this section of the plains is underlaid by a stratum of honeycomb rock from 15 to 20 ft. in thickness, through which flows an ample flow of water. The dip is from the northwest to the southeast. The company will cut ditches from three to four miles up the course of the draw, where it is only 7 ft. to water, and thus penetrate to the bottom of the water-bearing rock and draw off the water, which will be stored in reservoirs for distribution over the country.

FRESNO, CAL.—Surveys are being made on the San Joaquin River, 25 miles from here, for a dam by which to irrigate a large area in Madera county, and also to furnish power for an electric plant in this city. It is reported that manufacturers of electrical machinery have been asked for estimates for a plant of 1,000 to 3,000 HP.

SUSANVILLE, CAL.—E. T. Purser, of the Susan River Irrigation system, has been granted right of way over the public lands for the Norval flat reservoir, about 25 miles from this place, which contains 980 acres. It is said that plans for three more reservoirs are now being prepared. Ch. Engr., Albert Halen.

NEW COMPANIES.—Cheyenne County Ditch Co., Benhelman, Neb.; $3,000; Burt Coldren, S. C. Hall, L. C. Clark.

Alamedo Canal Co., Syracuse, Kan.; $2,500; Thompson Overton, C. F. Rose, John Howe, M. J. Clark.

Newton Irrigation Co., Alliveria, Neb.; $15,000; C. L. Copp, A. C. Abbott, Lyman Hopping, G. W. Abbott, William Mounlinger.

Horn Rapids Irrigation Co., North Yakima, Wash.; $50,000; to utilize the water of the Yakima River; H. K. Owens, J. B. Reavis.

SEWERAGE.

FARMINGTON, ME.—The state board of public health has recommended that a sewer system be constructed in this city.

BOSTON, MASS.—Bids are asked until Feb. 28 for furnishing the street department with iron castings, catch-basin covers, etc. B. T. Wheeler, Supt. of Sts.

CAMBRIDGE, MASS.—The committees of this city and Somerville are considering the question of constructing a joint sewer to drain Muller's Brook, with an outlet into the metropolitan sewer at Alewife Brook.

MEDFORD, MASS.—The commissioners have recommended that sewers be constructed in seven streets.

MILTON, MASS.—Geo. A. Kimball, of Boston, has prepared plans for a complete system, estimated to cost $208,420. The surveys were made by Chas. E. C. Breck, of Milton. Dr. M. V. Pierce, Chn. Com.; H. E. Sheldon, Secy.

TAUNTON, MASS.—The council has voted to petition the legislature for permission to construct a system.

AUBURN, N. Y.—Voorhees & Witmer; Waring, Chapman & Farquhar, and Geo. S. Pierson have submitted reports on the proposed Eighth and Ninth ward sewers.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements 2622 Third St., until Feb. 28, for constructing a sewer in Boscobel Ave.—J. N. Stewart has introduced a bill in the legislature providing for the construction of a sewer and highway through the counties of New York and Westchester along the Bronx River.

ROCHESTER, N. Y.—The board of health has approved the bill for the construction of the west side sewer, which will now be sent to the legislature.

YONKERS, N. Y.—John Madigan has been awarded a contract for building a sewer in four streets at $22,888.

PATERSON, N. J.—The board of trade has been discussing the question of purifying the Passaic River. The city engineer has recommended the extension of the sewers to the middle of the river and the filling in of depressions in the river, as these retain the sediment. Wise & Watson, of Passaic, recommended the intermittent filtration system of sewage disposal, which would require about 60 acres of land.

WESTFIELD, N. J.—It is reported that the construction of the system will be commenced in May. Engr., F. A. Dunham, Plainfield.

ERIE, PA.—Bids are asked until Feb. 28 for constructing 1,680 ft. of 18 and 15-in. pipe sewers in three streets. George Platt, Cy. Engr.

CLEVELAND, O.—Bids are asked until March 6 for constructing sewers in six streets. J. H. Farley, Dir. Pub. Wks.

HAMILTON, O.—Bids are asked until March 15 for constructing about 7,840 ft. of 12 to 84-in. pipe sewers. J. J. McMaken, Cy. Clk.

LOGAN, O.—We are informed that bonds have been voted for sewers, but that no plans have yet been adopted.

LORAIN, O.—The state board of health has denied the petition of this city to empty its sewage into Black River. The board has recommended that the character of the soil adjacent to the Black River be determined with reference to its fitness for purifying the sewage by intermittent filtration. C. O. Probst, Secy.

EVANSVILLE, IND.—It is reported that the city clerk has been directed to advertise for bids for constructing a sewer.

PEORIA, ILL.—Bids are asked until March 12 for constructing the Flora Ave. system. Isaac Taylor, Comr. Pub. Wks.

GRINNELL, IA.—It is stated that seven miles of sewers are to be constructed, but that only $10,000 will be spent this season. F. W. Wilson, Cy. Clk.

KEOKUK, IA.—The council has adopted the plans prepared by the city engineer for extending the main sewer to the river, a distance of 900 ft., 550 ft. of which will be a tunnel 11 × 10 ft. The first 100 ft. of the sewer will be 12 × 10 ft., and the last 250 ft. will be 11 × 9 ft. The deepest cut will be 60 ft. There will be 3,600 cu. yds of earth and 912 cu. yds. of rock excavation, and 1,040 cu. yds. of riprap filling and 617 cu. yds. of concrete filling.

WEST DULUTH, MINN.—The board of public works has been directed to advertise for bids for constructing a sewer.

ST. LOUIS, MO.—It is proposed to construct sewers in 12 streets.

SAN ANTONIO, TEX.—A correspondent writes us that Wilding, Marshall, Backus & Hinds, of Indianapolis were the second lowest bidders on the 74 miles of sewers, but the bid was thrown out with several others, including the lowest, for informalities, and these do not appear in any of the published statements of the bids. This firm has now been taken in to do the work and it is possible that the contract will be transferred to it entire. The construction has been commenced. The detailed price of some of the bids were published in our issue of last week.

GARBAGE DISPOSAL.

BRIDGEPORT, CONN.—It is reported probable that the board of health will contract with G. E. Winton to dispose of the garbage of the city this year at his rendering establishment.

MERIDEN, CONN.—A resolution has been introduced in the council directing the health committee to investigate if any changes are advisable in the present method of disposing of garbage and ashes.

TROY, N.Y. —The contracting board has been directed to advertise for bids for the removal of garbage during the ensuing year.

PITTSBURG, PA.—Bids are asked until March 1 for the collection, removal and disposal of garbage, offal and dead animals for four years from July 1. J. O. Brown, Dir. Dept. Pub. Safety.

DAYTON, O.—The board of city affairs has accepted an invitation of the Dixon Crematory Co. to visit Atlanta, Ga., and inspect the crematory in operation in that city.

DETROIT, MICH.—The city comptroller has been directed to advertise for bids for the collection of garbage for three years from June 30. It is stated that the Detroit Sanitary Wks. has the present contract at $52,500 per year.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Feb. 28 for furnishing the street department with granite flagging. B. T. Wheeler, Supt. of Sts.

ALBANY, N. Y.—The committee has voted to recommend the paving of three streets.

BROOKLYN, N. Y.—Bids are asked until March 1 for flagging portions of sidewalks in 23 streets. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—The council has directed the board of public works to prepare plans and to advertise for bids for constructing a large number of hard material sidewalks.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements until Feb. 28 for grading, etc., portions of four streets.

NIAGARA FALLS, N. Y.—It is reported that the board of public works has advertised for bids for paving portions of Main and Falls Sts. with asphalt, estimated to cost about $59,000.

SCHENECTADY, N. Y.—Bids are asked until Feb. 26 for 31,000 sq. yds. of sheet asphalt paving on concrete, and 16,000 sq. yds. of granite block paving. Lewis B. Sebring, Cy. Engr.

UTICA, N. Y.—The council has ordered about 9,734 lin. ft. of asphalt paving, estimated to cost $87,606.

WESTFIELD, N. Y.—The town has voted to issue $40,000 in bonds for improving the roads.

HOBOKEN, N. J.—A road is to be constructed in Weehawken township, Hudson county. Ch. Engr., E. W. Harrison.——A portion of Paterson Ave. is to be improved. M. V. McDermott, Cy. Clk.

PATERSON, N. J.—Bids are asked until March 1 for the purchase of $20,000 in 5% bonds for building county roads. A. B. Pearce, Clk. Bd. Freeholders.

TRENTON, N. J.—The council is considering the question of paving several streets.

ALLEGHENY, PA.—The prices of the successful bid, that of C. I. McDonald, for improving Perrysville Ave. rfom Carroll St. to the city line, were published last week. A correspondent writes us that the total bids were as folows, (1) being for granite blocks and sheet asphalt paving, with either flagstone or granolithic sidewalks; (2) for Ligonier blocks, and sheet asphalt paving with flagstone sidewalks, and (3) same paving with granolithic sidewalks:

	1.	2.	3.
Joseph Hastings	[1]$431,270	$408,850	$403,450
Sicilian Asphalt Paving Co.	[2]423,500	400,700	389,900
Sloan, McIlvain & Ott Bros.	.....	399,660	394,260
Fred. Gwinner, Jr.	.....	393,750	388,460
James H. McQuaid	410,030	399,390	399,390
Booth & Flinn, Ltd.	393,770	355,770	355,770
C. I. McDonald	379,985	353,385	353,385
Wm. J. Dunn	424,150	.....	393,750

[1] With flagstone sidewalks, $431,270; granolithic, $425,070. [2] With flagstone sidewalks, $423,500; granolithic, $412,700.

ERIE, PA.—A correspondent writes us that about 40,000 sq. yds. will be paved with brick and 21,000 sq. yds. with sheet block asphalt. There is also 3,600 sq. yds. of asphalt block paving under contract, which will be laid in April. George Platt, Cy. Engr.

TURTLE CREEK, PA.—Bids are asked until Feb. 23 for paving three streets. C. E. Kiester, Borough Clk.

ATLANTA, GA.—The council is considering the question of paving Butler and several other streets with Belgian blocks and one street with brick.

MACON, GA.—An election will be held April 11 to vote on a proposition to issue $30,000 in bonds for paving.

JACKSONVILLE, FLA.—The board of public works has adopted resolutions for paving two streets with brick, estimated to cost about $9,000, and one street with Alachua rock, estimated to cost $1,308. W. C. West, Secy. Bd. Pub. Wks.

LOUISVILLE, KY.—Bids are asked by the board of public works until Feb. 27 for paving several streets with brick.

LOUISVILLE, KY.—Bids are asked by the board of public works until March 5 for paving portions of nine streets with brick and for furnishing stoneware pipe, cement and lime until Jan. 1, 1896.

COLUMBUS, O.—The widening of North High St. is being discussed by the council, estimated to cost $207,407, of which $59,107 is for paving, resetting curb, etc.

CLEVELAND, O.—Bids are asked until March 1 for paving five streets each with brick and Medina sandstone blocks. J. H. Farley, Dir. Pub. Wks.

MARION, O.—Bids are asked until March 14 for improving a number of streets. James Williams, Cy. Clk.

NEWARK, O.—Bids are asked, according to reports, until April 1 for 20,000 sq. yds. of brick paving.

ANDERSON, IND.—Bids are asked by the board of turnpike directors of Madison county until March 21 for gravelling roads as needed during the ensuing year. R. C. Howard.

BLOOMFIELD, IND.—Bids are asked until March 7 for the construction of a gravel road in Jefferson township. H. C. Owen, Chn. Bd. Comrs.

INDIANAPOLIS, IND.—The board of public works has directed that plans be prepared for 2,000 lin. ft. of asphalt paving in Indiana Ave., width, 60 ft. The date for awarding the contract for paving South Pennsylvania St. with brick has been postponed, and notice of amount and time of letting will appear next week.

TERRE HAUTE, IND.—Bids are asked until March 5 for paving two streets with gravel. C. H. Goodwin, Cy. Clk.

DETROIT, MICH.—The board of public works has recommended that one street be paved with brick, estimated to cost $50,000; three with cobblestones or granite blocks, to cost $21,500, and four with cedar blocks, to cost $41,500.

MONROE, MICH.—Bids are asked until March 11 for paving Front St. with brick. John Steiner, Cy. Clk.

AUSTIN, ILL.—E. L. Austin, Town Clk. of Cicero, writes us that Kissack & Muir have been awarded the contract for paving Ohio St. with brick at $4,244. There were seven bids, the highest being $6,014.

GREEN BAY, WIS.—D. C. Gayton has prepared plans and specifications for paving Main St. from East River to the city limits.

DES MOINES, IA.—Bids are asked by the board of public works until Feb. 23 for 23,331 lin. ft. of curbing, 35,290 cu. yds. of grading, and 34,231 sq. yds. of brick paving.

GRAND MARAIS, MINN.—A bill has been introduced in the legislature appropriating $10,000 to aid in the construction of three wagon roads in Cook county.

KANSAS CITY, MO.—Bids are asked until Feb. 27 for constructing stone, artificial stone, or brick sidewalks in Wall St. and grading portions of five streets. H. H. Filley, Cy. Engr.

HOUSTON, TEX.—Bids are asked until March 4 for constructing brick, stone, cement or asphalt sidewalks in two streets. John T. Browne, Mayor.

DENVER, COLO.—Bids are asked until Feb. 25 for 3,000 cu. yds. of grading. A. C. Harris, Pres. Bd. Pub. Wks.

LOS ANGELES, CAL.—It is proposed to grade two streets and construct cement sidewalks and curbs on one street. P. A. Howard, St. Supt.

RIVERSIDE, CAL.—The council is considering the question of brick, asphalt and macadam paving. J. W. Johnson, Cy. Engr.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

LEVEE WORK.—Shreveport, La.—Bids are asked until March 5 for 227,000 cu. yds. of levee construction. S. N. Kerley, Secy. Caddo Levee Bd.

IRON FENCE, ETC.—Riverside, O.—Bids are asked until March 19 for an iron fence and stone wall around a new school building lot. J. M. Barkley, Chn. Com.

CEMENT.—Montgomery, Ala.—Bids are asked until March 23 for 10,000 bbls. of cement, as stated in our advertising columns. Maj. F. A. Mahan, U. S. Engr. Office.

TELEGRAPH WIRE.—Wichita Falls, Tex.—Bids are asked by the Wichita Falls Construction Co. for the necessary materials to build 18 miles of telegraph line with two wires.

DREDGING.—Montgomery, Ala.—Bids are asked until March 23 for dredging in Apalachicola Bay, Fla., as stated in our advertising columns. Maj. F. A. Mahan, U. S. Engr. Office.

CANAL.—Ottawa, Ont.—Bids are asked until March 23 for the construction of 6½ miles of the Trent Canal on the Petersboro & Lakefield division. J. H. Balderson, Secy. Dept. Rys. and Canals.

BLOCK SIGNAL.—Baltimore, Md.—Press reports state that the engineers of the B. & O. R. R. Co. are considering the advisability of equipping the Pittsburg & Western division with the block signal system.

DREDGING AND REMOVING LEDGE.—Newport, R. I.—Bids are asked until March 20 for dredging and removing ledge rock, as stated in our advertising columns. Capt. W. H. Bixby, U. S. Engr. Office.

BOILER AND ENGINE.—Tompkinsville, N. Y.—Bids are asked until March 5 for a new boiler and engine for the tender, "Rose," as stated in our advertising columns. Lieut.-Col. Peter C. Hains, U. S. Lighthouse Engr.

MASONRY FOUNDATIONS.—Providence, R. I.—Bids are being received for the masonry foundation of the new passenger station, according to a press report; the work to include a wall 24 ft. high, 10 ft. thick and about 1,200 ft. long.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until Feb. 26 for sundry supplies for the Washington navy yard and for a quantity of nickel steel plates at Newport News. Edwin Stewart, Paymaster General, U. S. N.

MASONRY CULVERT.—South Bend, Ind.—Bids are asked until March 14 for the construction of a stone or stone and brick arch culvert, 16 ft. span and 66 ft. in length, as stated in our advertising columns. John F. Meighan, Supt. Comrs.

RETAINING WALL.—Paterson, N. J.—Bids are asked until March 1 for building a retaining wall with guard rail on River St. between Mulberry and Prospect Sts. The work will require about 500 cu. yds. of masonry. David F. Dunca, Chn. Com.

IRON-CUTTING MACHINERY.—Chicago, Ill.—The Columbian Exposition Salvage Co., Western Union Building, wishes an improved device for cutting up the many thousands of tons of structural iron from the World's Fair buildings. It is stated that much of the material cannot be sheared economically.

CANAL EXCAVATION.—Butte, Mont.—Bids are asked by the Parrot Silver & Copper Co. until March 1 for the construction of a canal upon the east side of Jefferson River in Madison county, each bid to state the price per cubic yard for loose earth, loose rock, and hard rock excavation. J. H. Harper, of Baker & Harper, 222 North Main St., is the engineer in charge.

CANAL.—Pittsburg, Pa.—A press report states that the engineering committee of the chamber of commerce met Feb 15, and decided that Geo. M. Lehman, of Philadelphia, should have direct charge of the surveys for the projected Ohio River & Lake Erie ship canal. J. C. Oliphant, of Uniontown; John A. Garber, of Mercer, and W. C. Mobley, of Pittsburg, were appointed chiefs of corps. Each will have 14 assistants. The corps will be organized soon and the final survey will be completed before summer.

JETTY WORK.—Velasco, Tex.—A press report from this city states as follows: Everything along the river front has a busy look. The contractors are pushing the work preparatory to beginning active operations on the jetty in as short a time as possible. The first bargeload of brush went to the mouth of the river this morning. D. S. Cage, the brush contractor, has a large force cutting brush up the river. Idle workingmen contemplating coming here and finding work will be sorely disappointed, as preference will be given those who live here, and especially those with families. It is expected rock will begin arriving this week.

DRAINAGE.—St. Paul, Minn.—The Red River drainage commission has submitted the following estimates for completing the main drainage canals: Spring Creek, Norman county, $13,220; Middle River, Marshall county, $15,834; Otter Tail River, Wilkin county, $5,887; Rabbit River, Grant county, $15,274; Buffalo River, Clay county, $13,948; Manston Slough, Wilkin county, $15,262; Thompson's Coulee, Clay and Wilkin counties, $15,262; extension of Ada canal, improvement of Wild Rice River, Norman county, $5,000; improvement on Grand Marias, Norman county, $10,000; extensions of Mistinka River ditch eastward two miles into Traverse county, $3,000; ditches in Clay county, $12,000; total $124,687. For surveys, etc., $12,468. Total already contracted for, $90,000. Amount appropriated, $125,000. Balance needed, $102,155.

METAL MARKET PRICES.

LEAD.—New York: 3.1 to 3.12 cts. Chicago: 3 to 3.05 cts. St. Louis: 2.92 to 2.95 cts.

NAILS.—Pittsburg: 90 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.25 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $10 to $11.25. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.1 to 1.5 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.75 to 1.85 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater: old rails, $11 to $11.50 for iron, and $10 for steel; steel rails fit for relaying, $14.00; light rails, $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12 to $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10.50 to $11 for iron, and $7 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35

to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.5 cts.; channels, 1.2 to 1.25 cts.; angles, 1.05 to 1.15 cts.; tees, 1.2 to 1.5 cts.; universal mill plates, 1.05 to 1.15 cts.; steel plates, 1.15 to 1.2 cts. for tank, 1.75 to 2.5 cts. for shell, 1.35 to 1.4 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts; channels, 1.4 to 1.45 cts.; angles, 1.3 to 1.35 cts.; tees, 1.65 to 1.7 cts., universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

CONTRACT PRICES.

SEWERS.—Paterson, N. J.—The following bids were received Feb. 12 for constructing a sewer in East and West Railway Ave., and other streets; John Rainey, Clk. to Cy. St. Comr.:

Bids Received at Paterson, N. J., for Constructing a Sewer.

Bidders.	40-in. brick vit. invert, 1,700 lin.ft.	40-in. brick cement invert.	36-in. brick vit. invert, 900 lin. ft.	36-in. brick cement invert.	Manholes, each, 30.	Catch basins, each, 10.	Receiving basins, each, 2.	Sandstone, hard, 100 cu. yds.	Sandstone, soft, 50 cu. yds.	Bluestone, 5 cu. yds.	Timber, M. ft.	Concrete, 2 cu. yds.	6-in. house connections, 1,500 lin.ft.
McKiernan & Bergin.	$3.32	$3.32	$2.83	$2.83	$20	$20	$100	$2.50	$2.50	$2.50	$15.00	$3.00	$0.25
Dunn & Cortese	3.50	3.50	2.75	2.75	21	24	81	1.00	.50	....	15.00	....	.28
Patrick McShane	2.60	2.60	2.36	2.36	19	18	95	3.98	.75	.01	12.00	.01	.23
Samuel Crawford	4.22	4.22	3.40	3.40	20	20	85	.75	.25	....	12.00	4.00	.24
James Finnegan	3.70	3.70	3.00	3.00	18	18	90	1.50	.25	1.25	14.50	4.00	.20
James Collins	4.00	4.00	3.70	3.70	20	23	80	2.00	1.00	4.00	16.00	1.00	.22
Robert Downie	3.40	3.40	2.95	2.95	15	19	75	.80	.10	....	15.00	....	.21
Joseph Richards	4.40	4.40	4.00	4.00	17	16	70	1.50	.50	.20	16.00	2.00	.23
Joseph Pugila	3.75	3.75	3.75	3.75	16	20	90	1.00	.50	....	16.00	....	.25

TORPEDO BOATS.—Washington, D. C.—The following bids were received at the Navy Department Feb. 19 for three metallic twin-screw seagoing torpedo boats of about 138 tons displacement, with a speed of 24½ knots maintained for at least two consecutive hours, for which there is an appropriation of $450,000.

Bath Iron Works, Bath, Me.—Department plan, all three boats, $142,000 each; total, $426,000.

John H. Dialogue & Son, Camden, N. J.—Department plan, one boat, $139,000; two boats, $137,000 each; three boats, $136,000 each; total, $408,000.

Columbian Iron Works, Baltimore, Md.—Modified plan, one boat, $107,000; two boats, $103,000 each; three boats, $97,500 each; total, $292,500.

Hugh Ramsay, Perth Amboy, N. J.—Five proposals; modified plan, all three, $438,000; another modified plan, all three, $378,000; department plan, all three, $378,000; department plan, all three, $347,000; modified plan, all three, $347,000.

Union Iron Works, San Francisco, Cal.—Department plan, one boat, $135,000; two boats, $129,000 each; three boats, $120,000 each; total, $360,000; modified plan, one boat, $125,000; two boats, $120,000 each; three boats, $116,000 each; total, $348,000; modified plan, larger boat, 240 tons displacement and 28 knots speed, one boat, $243,000.

Fulton Engineering & Shipbuilding Works, San Francisco, Cal.—Department plan, one boat, $148,000; two boats, $145,000 each.

Iowa Iron Works, Dubuque, Ia.—Department plan, all three, $137,000 each; total, $411,000.

Herreshoffff Mfg. Co., Bristol, R. I.—Modified plan, three steel of 138 tons, $113,850 each; total, $341,550; modified plan, three bronze hull, aluminum top boats, $138,000 each; total, $414,000; modified plan, one steel boat, $113,815; two composite boats, $138,000 each; total, all three, $389,815; modified plan, one composite boat, $138,000; two steel boats, $113,850; total, $365,700.

Press reports state the contract price for the Cushing, 105 tons, was $82,750, or $788 per ton; for the Ericsson, 120 tons, $113,500, or $946 per ton, while the lowest bid for the three new vessels of 138 tons is $97,500, or $706 per ton. Each boat is to be armed with three 1-pounders and three 18-in. torpedo tubes, each of which is to have four Whitehead torpedoes, 18 ins. caliber. The torpedo launching tubes are to have a train to all points of the compass.

DREDGING.—Cleveland, O.—The following bids were received for dredging the river for five years: George Lockerbie, Detroit, $83,550; L. P. & J. A. Smith Co., $114,410; W. E. Roney, $129,840; G. H. Breymann & Bro., $124,975; John Stang, $161,256; W. J. Gawne and George S. Stewart, $163,057. The lowest bid is at the rate of 10 cts. per cu. yd. for excavating and dumping in the lake, 10 cts. for excavating and dumping on the bank, and $8 an hour for tugging.

HIGHWAYS.—Trenton N. J.—Joseph L. Watson, County Engr., writes us that the following bids were received Feb. 12 for constructing two public roads in Mercer county, both contracts being awarded to Robt. A. Montgomery; (1) being the bid for Extra road, and (2) for Greenwood Ave. road:

Bids Received at Trenton, N. J., for Constructing Public Roads.

	10-in Telford, per sq.yd.	Macadam, per sq. yd. 10-in.		Macadam, per sq. yd. 8-in.		Macadam, per sq. yd. 6-in.		Extra: Stone, per in. deep, per sq.yd.		Extra: Excavation, per cu.yd.		Extra: Haul, per cu.yd.		Extra: Shouldering, per cu.yd.	
Bidder.		1.	2.	1.	2.	1.	2.	1.	2.	1.	2.	1.	2.	1.	2.
[1]R. A. Montgomery	$0.67	$0.63	$0.67	$0.63	$0.58	$0.55	$0.50	$0.50	$0.12	$0.12	$0.40	$0.25	$0.25	$0.25	$0.90	$0.90
[2]N.J.Pavg &Const'n Co.	.81	.71	.81	.71	.70	.60	.45	.40	.11	.11	.35	.35	.05	.05	.95	.95
[2]P. J. Berry	.90	.80	.90	.80	.80	.70	.70	.65	.10	.10	.20	.20	.10	.10	.75	.75
[3]John H. Hurley	.94	.69	.94	.68	.75	.54	.56	.45	.095	.07	.30	.30	.12	.12	.79	.75
[3]Wm. S. Keihn	.95	.85	.79	.74	.73	.68	.68	.64	.10	.09	.30	.30	.10	.10	.75	.75
[3]Barber & Ireland	.95	.83	.95	.83	.75	.70	.60	.60	.10	.10	.22	.22	.05	.05	.70	.70

[1] Lambertville, N. J. [2] Trenton, N. J. [3] Philadelphia, Pa.

The Extra road (column 1) begins at the borough line of Hightstown and runs outward away from the borough and railway, the nearest point of the road being about one-quarter of a mile from the railway. This road will be 14 ft. wide. The Greenwood Ave. road (column 2) begins at the city line of Trenton, and runs outward 1.57 miles. It will be 16 ft. wide. This county built four roads last year, all chiefly of 10-in. macadam, and these will probably be built of same material.

CAST IRON PIPE, LEAD PIPE, AND PIG LEAD.—Worcester, Mass.—A contract for 2,300 tons of cast iron water pipe has been awarded to the Warren Foundry & Machine Co., at $18 per net ton. This is reported as a very low bid, considering the delivery. The contract for special castings was awarded to P. Pero, of Worcester, at 1¼ cts. per lb. for new castings, 40 cts. per 100 lbs. to be allowed for old ones. A contract for about a ton of lead pipe and 40 tons of pig lead was awarded to the Boston Lead Co., at 4 1-5 cts. per lb. for pipe and 3 1-5 for pig lead, delivered at any part of Worcester. The Chadwick Lead Co., of Boston, bid the same prices, delivered f. o. b. cars Worcester, and P. Baker, of Worcester, bid 4 1-5 and 3.28 cts., respectively, for pipe pig lead.

RIVER WORK.—Columbus, O.—The state board of public works has opened the following bids for deepening, widening, and straightening the Miami River in Logan county from the outlet of the Lewiston reservoir to Long's dam, for which the legislature appropriated $10,000: Louis Pickering, Bellefontaine, 17 cts. per cu. yd.; R. F. Walker and S. K. Robinson, Troy, 9.8 cts.; John Van Sky, Lima, 14 cts.; C. B. Donaghy & Co., Portsmouth, 18 cts.; Behymer & Co., Celina, 9¾ cts.; Pollard, Goff & Co., Champaign, Ill., 9½ cts. The contract will probably be let to the last-named bidder.

Bids for Pipelaying, Beaver Falls, Pa., Water-Works.

		Chandley Bros. & Co., Beav'r Falls.	Gianini & Verik, Pittsb'g.	Shaller & Schniglau, Chicago.	F'nkh's'r & Ramsay, Beav'r F'ls.	A. Tubman, Galipolis, O.	Cronin & O'Herron, Pittsb'g.	M'Ganegly & Bennett, Greensb'g.
16-in. pipe,	16,700 ft.	$0.29	$0.55	$0.33	$0.35	$0.345	$0.35	$0.35
12-in. "	5,600 "	.25	.42	.27	.26	.28	.30	.32
10-in. "	9,200 "	.23	.38	.23	.23	.22	.23	.26
8-in. "	14,500 "	.20	.27	.18	.20	.175	.20	.23
6-in. "	42,700 "	.18	.23	.16	.18	.155	.17	.19
4-in. "	7,200 "	.16	.18	.15	.15	.125	.15	.17
Brick masonry,	17 cu.yds.	10.00	13.00	7.00	8.25	7.00	10.00	7.50
Rock excavation	1,000 " "	2.00	2.00	2.25	1.50	2.50	2.50	1.50
Repaving,	12,000 sq. ft.	.05	.08	.10	.08	.12	.08	.10
Total		$22,867	$33,246	$23,239	$23,683	$23,268	$24,510	$25,528

Bids for Reservoir, Beaver Falls, Pa., Water-Works.

		Owen Patterson & Co. Bltmre.	Chandley Bros. & Co.	Gianini & Verik.	Shaller & Schniglau.	Funkhauser & Ramsay.	J.W.Kelly, N. Brighton, Pa.	A. Tubman.	McGanegly & Bennett.
Earth excav.	18,000 cu.yds.	$0.25	$0.27	$0.28	$0.25	$0.30	$0.35	$0.29	$0.25
Rock "	500 " "	.50	.55	.65	2.25	.55	.90	.69	.65
Puddle,	100 " "	.80	1.00	1.00	.55	1.25	1.00	.69	1.00
Concrete,	20 " "	4.50	4.25	5.00	5.00	5.00	4.00	3.75	3.00
Rock mas. cmt.	20 " "	5.00	5.00	5.00	5.50	5.15	3.10	4.00	4.00
Dry mas. cmt.	120 " "	4.00	4.40	4.00	3.25	4.00	2.40	3.50	2.50
Brick cement,	10 " "	8.00	7.00	13.00	7.50	8.25	9.00	7.75	7.50
Cut stone:									
Rock face	2 " "	10.00	9.00	7.00	27.00	7.00	7.25	8.00	8.00
Cut face,	2 " "	10.00	10.00	8.00	27.00	9.20	10.75	10.00	9.00
Brick lining:									
Side	4,300 sq.yds.	.65	.65	.90	.55	.75	.65	.72	.65
Edge,	1,600 " "	.90	.90	1.40	1.10	1.18	1.00	1.01	.90
End,	350 " "	1.40	1.30	2.40	2.20	2.15	2.10	2.02	1.30
Dress'd coping,	880 lin. ft.	.75	.70	1.00	.75	.75	.75	.85	.70
Lay'g 24" pipe,	200 " "	1.20	1.50	1.00	.90	1.25	1.00	.75	.75
" 16" pipe,	200 " "	.85	1.00	.70	.50	1.00	.65	.45	.60
" 6" pipe,	200 " "	.25	.25	.25	.30	.20	.45	.31	.20
Fencing,	2,300 " "	.25	.42	.70	.30	.70	.80	.27	.25
Total		$12,005	$12,864	$15,765	$13,023	$15,208	$15,441	$13,396	$11,531

CAST IRON PIPE.—Sacramento, Cal.—O. S. Flint, Cy. Clk., writes us that a contract for 3,600 ft. of 6-in cast iron water pipe has been awarded to Frank Lyman, of Sacramento, at 39⅝ cts. per ft.

RUBBER VALVES.—Minneapolis, Minn.—A contract for 300 rubber valves for the water-works department has been awarded to the W. S. Nott Co., at 43¼ cts. per lb., the other bids being: Revere Rubber Co., 50 cts. per lb. for first grade, 43 cts. for second grade; Goodyear Rubber Co., 50 cts. per lb.

DREDGING.—Boston, Mass.—Frederick N. Wales, Clk. Harbor Comrs., writes us that the contract for 27,500 cu. yds. of dredging in front of Cunard wharf has been awarded to the Eastern Dredging Co., 25 Congress St., at $11,950, the Old Colony Dredging Co., 12 Pearl St., bidding $12,000, and the New Eng. and Dredging Co., 12 Post Office Square, $12,300.

WATER-WORKS.—Beaver Falls, Pa.—Contracts for materials and constructing works have been awarded as follows; Engrs., Jas. H. Harlow & Co., Pittsburg: 200 hydrants, with 6-in. connection, Bourbon Copper & Brass Wks., Cincinnati, at $19.68 or $19.30 for 4-in.; other bids being: Ludlow Valve Mfg. Co., $21.44; R. D. Wood & Co., $20.50; Carlin Mfg. Co., $20.30; Jonson Engineering & Foundry Co., $20.; Keystone Driller Co., $21 or $20; Chandley Bros. & Co., $21; Shaller & Schniglau, $19.75; A. Tubman, $20.50 or $20. Pipe, Anniston Pipe & Foundry Co., 15 tons of 24-in., 1,033 of 16-in., 226 of 12-in., and 275 of 10-in., at $17.90, and 290 tons of 8-in., 642 of 6-in. and 70 of 4-in., at $18.05; 60 tons of specials at $40. The bids for valves and valve boxes were as follows:

		Ludlow Valve Co.	R.D.Wood & Co.	Rensselaer Mfg. Co.	Jonson Eng. Co.	Bourbon C. & B. Wks	Chandley Bros. & Co.	Shaller & Schniglau.	A. Tubman.
Valves:		$	$	$	$	$	$	$	$
16" check,	1.	55.00	55.00	58.00	..	58.00	55.00	58.00	58.00
20" gear'd,	1.	....	85.00	83.60	85	92.50	90.00	85.00	92.50
16" "	21.	58.00	55.00	55.00	65	57.00	58.00	55.00	57.00
16" "		48.75	50.00	53.00	60	52.00	49.00	....	53.00
12" "	7.	25.90	25.00	27.50	32	26.50	25.90	28.50	26.60
10" "	13.	20.50	20.00	21.50	28	19.60	20.50	22.50	19.60
8" "	28.	14.25	15.00	15.50	..	15.10	14.25	16.50	15.10
6" "	60.	9.50	10.50	10.20	..	9.75	9.50	11.25	9.75
4" "	22.	5.80	5.90	6.20	..	5.40	5.80	7.00	5.60
Boxes	130.	2.40	2.25	2.30	..	2.25	2.40	2.70	2.30
		3,039	3,202	3,250*	..	3,207	3,129	3,432	3,218

*Lump bid of $2,775 for valves, or $2,905 for valves and boxes (awarded contract).

The contracts for pipelaying and wells were awarded to Chandley Bros. & Co., at $22,867 and $11,000, respectively, and that for a reservoir to McGanegly & Bennett, Greensburg, Pa., at $11,531, the bids for pipelaying and reservoir being as follows:

VALVES, PIPE AND HYDRANTS.—Minneapolis, Minn.—F. W. Cappelen, Cy. Engr., writes us that the contract for valves for use during 1895 has been awarded to the Eddy Valve Co., Waterford, N. Y., at the following prices: 6-in. Eddy double gate valve, $11.50 each; 8-in., $17.50; 12-in., $32; 16-in., $63; 24-in., $168; $25 additional for 4-in. by-pass for the 24-in. valve. These prices are for valves delivered f. o. b. cars Minneapolis. A contract for 3,000 tons of 24 to 6-in. cast iron water pipe was awarded to Dennis Long & Co., at $19.74 per ton of 2,000 lbs., f. o. b. cars Minneapolis. The following bids were received for 10-ft. hydrants of the Mathews pattern with and without frost jackets:

Bidder.	Mathews hydrants—Without frost jacket.	Mathews hydrants—With frost jacket.
R. D. Wood & Co., Philadelphia	$25.70	$29.00
South Park Foundry Co., St. Paul.	24.40	29.40
Northwestern W. & F. Co., St. Paul.	21.24	28.00
Wm. S. Hall, Minneapolis	29.00	36.50

Last year the contract price for hydrants without frost jackets was $27.00, and with frost jackets $32.50, furnished by the South Park Foundry Co., of St. Paul. In 1893 the city paid $32.00 for hydrants, and in 1892, $36.00, without frost cases.

DRAINAGE EXCAVATION.—Vincennes, Ind.—Contracts for constructing about 27 miles of the Swan Pond Drain in lower Vincennes township have been awarded to Harding & Sons, of La Porte, Ind., at $41,577, the prices ranging from 7½ to 9 cts. per cu. yd. The other bidders included A. V. Wills & Sons, Pittsfield, Ill.; Pollard & Goff, Champaign, Ill.; James Bonewitz, Monroe City, Ind., and Jordan Bros., Decker, Ind.

GARBAGE DISPOSAL.—Buffalo, N. Y.—The contract for the collection and removal of ashes, cinders, garbage and kitchen and general refuse for three years was awarded Feb. 12 to John S. Johnson at 45 cts. per cu. yd. for ashes and from $1.85 to $2.50 per cu. yd. for garbage, amounting to about $110,141 per year.

ARTESIAN WELL.—Nevada, Mo.—A press report states that Chas. F. Strohm, Receiver of the Nevada Water Co., has awarded a contract for sinking a well ..

to a depth of 1,000 ft. to George W. Dudley & Co., of St. Louis. The well is to be 12 ins. in diameter to a depth of 500 ft., and 10 ins. the remainder of the depth. The contract price is $2.50 per ft. for the first 500 ft., and $3 per ft. for the remaining 500 ft. There were 17 bids. It is thought an artesian flow will be reached at a depth of about 900 ft. The object of the company is to secure a supply of well water to take the place of that supplied now by the Marmaton River, a small, mud-bottomed stream.

SHAFT EXCAVATION.—Washington, D. C.—Jos. P. Frizell, Engr. Great Falls Power Co., writes us that the work at Great Falls consists in the sinking of a preliminary shaft for wheel pits to a depth of 70 ft., being 10 ft. below low water of the river; to be of such dimensions as the contractor finds convenient, not less than 6 × 8 ft. The bids were opened Feb. 16, as noted in our issue of last week, and the contract awarded to Breen & Feely, Alexandria, Va., at $6, $7, $9, $11, $13, $15 and $18 per lin. ft., respectively for the seven sections, the other bids being as follows:

	Per lin. ft.
J. Foley, Washington	$23.15
Martin McNamara, Washington	27.00
J.H. Hobson, Washington, first 50 ft. $8; remainder	10.00
Bolace Bros., Washington,	11.00
A. Davis, Jr., Fairfax county, Va.	56.00
Lawson & Davenport, Washington,	13.50
Cogan & Killeen, Georgetown	18.00
Stewart Grannelle, Uniontown, Pa.	35.00
Langhorn & Elliott, Washington	13.10
J. P. McAtee & Co., Washington	60.00

SEWERS AND BRICK PAVING.—East St. Louis, Ill.—Alex. H. Abend, Cy. Engr., has sent us a statement of the bids received Feb. 9 for improving St. Louis Ave. Bids are submitted on 16 different varieties of brick.

Bids Received at East St. Louis, Ill., for Improving St. Louis Ave.

Quantities.	Thos. J. Peters, Chicago.	J. E. Riley, Omaha, Neb.	Penny Meyers, Const'n Co.	N. G. Jung, Burlington, Ia.	Francis McCabe	Casp. Stolle.	Vieths, Stiefel & Skralinka.	Fruin-Bambrick Const'n Co.	T. J. Prosser.	Hill & O'Meara.
Eighth St. to City Line:										
Filling ..... 1,200 cu. yds.	$0.45	$0.33½	$0.29	$0.45	$0.35	$0.38	$0.40	$0.40	..	$0.24
Curbing ..... 12,500 lin. ft	.48	.49	.48	.48	.41	.42	.45	.45	..	.45
30-in. pipe sewer..... 1,700 "	2.20	1.80	1.88	1.90	2.00	1.95	1.87	1.90	..	1.82
24-in. " " ..... 2,400 "	1.00	.92	.92	.96	.86	.89	.74	1.02	..	.70
20-in. " " ..... 1,400 "	.75	.80	.64	.77	.70	.73	.57	.73	..	.54
15-in. " " ..... 1,150 "	.50	.20	.41	.42	.50	.38	.32	.41	..	.28
10-in. " " ..... 1,700 "	.20	.15	.19	.21	.24	.18	.16	.20	..	.15
6-in. " " ..... 18,000 "	.11	.10	.095	.10	.12	.08	.09	.095	..	.08
Sewer excavation .... 12,000 cu.yds.	.24	.21	.21	.20	.25	.19	.22	.21	..	.18
Surface " .... 14,500 "	.20	.20	.20	.35	.36	.15	.19	.38	..	.18
Br'k for m'holes, etc., 110 M.	13.50	11.00	12.75	12.00	15.00	12.00	13.25	10.90	..	13.00
Stone inlets and covers 44	15.00	11.00	14.00	14.50	12.00	12.50	12.25	13.25	..	15.00
Iron caps for m'holes.. 18	10.00	10.00	11.00	5.00	11.00	9.00	11.50	10.65	..	13.00
Brick paving ..... 35,450 sq. yds	1.32 to 1.73	1.29	1.25 to 1.44	1.39 to 1.58	1.13 to 1.30	1.29 to 1.60	1.35 to 1.50	1.42 to 1.98	.. to ..	1.27 to 1.42
Eighth St. to Collinsville Ave.:										
Filling ..... 38,000 cu.yds	..	$0.33½	...	...	$0.32	$0.53	$0.44	$0.45	$0.33	$0.34
Curbing .... 2,800 lin. ft	..	.48	...	...	.41	.40	.53	.46	.48	.45
24-in. pipe sewer..... 1,550 "	..	.92	...	..	.95	.89	.74	.99	.92	.70
10-in. " " ..... 252 "	..	.20	...	...	.25	.18	.16	.18	.19	.15
6-in. " " ..... 6,000 "	..	.10	...	...	.15	.08	.09	.10	.095	.08
Sewer excavation .... 1,200 cu.yds.	..	.21	...	...	.25	.20	.22	.21	.21	.18
Br'k for m'holes, etc. 45 M	..	11.00	...	...	15.00	12.00	13.25	11.05	12.75	13.00
Stone inlets and covers 7	..	11.00	...	...	12.00	12.50	12.25	13.25	14.00	15.00
Iron caps for m'holes. 4	..	10.00	...	...	11.00	9.00	11.50	10.65	11.00	13.00
Brick paving ..... 8,500 sq. yds.	..	1.27 to 1.47	...	...	1.16 to 1.34	1.29 to 1.60	1.43 to 1.70	1.55 to 1.98	1.25 to 1.44	1.27 to 1.46

INDUSTRIAL NOTES.

THE MICHIGAN-PENINSULAR CAR CO., of Detroit, Mich., has an order for 1,500 freight cars for the New York Central R. R.

THE CANTON STANDARD BRICK CO., of Canton, O., had its plant at North Industry destroyed by fire Feb. 14, involving a loss of about $25,000.

THE GEAUGA FOUNDRY & MFG. CO., of Painesville, O., is putting on the market a brick and mortar hod made from a single sheet of steel bent to shape.

THE DEAN BROS. STEAM PUMP WORKS, of Indianaolis, Ind., are bringing out a new style of duplex pump for operating high-pressure hydraulic machinery.

THE NORTHWESTERN SEWER PIPE CO., of Sioux City, Ia., is a reorganization of the Northwestern Sewer Pipe & Tile Co., and has a capital stock of $300,000.

THE IRON CITY FOUNDRY, of Pittsburg, Pa., had its main building destroyed by fire Feb. 19, involving a loss of about $30,000. The pattern shop was damaged, but was saved from destruction.

THE LLOYD BOOTH CO., of Youngstown, O., which makes a specialty of tin plate machinery, reports that it is receiving more inquiries at present than ever before for tin mill machinery.

THE PITTSBURG BRIDGE CO., of Pittsburg, Pa., has a contract for a drawspan and approach to carry the Jacksonville, St. Augustine & Indian River R. R. over the St. John's River at Palatka, Fla.

THE SHEDD WATER METER CO., of Worcester, Mass., will establish manufacturing works either at Millbury or Worcester. Messrs. Shedd & Clarke, civil engineers, of Worcester, are at the head of the concern.

THE BABCOCK & WILCOX CO., of New York, has an order for boilers of 1,500 HP., to carry 250 lbs. pressure, for a freight steamer now being built by the Chicago Shipbuilding Co. The order was obtained through Pickands, Mather & Co., of Cleveland, O.

THE SUPERIOR STEEL CO., of Pittsburg, Pa., manufacturing hot and cold rolled steel, is enlarging its plant and putting in new machinery, and has established a new department for hardening and tempering steel.

THE UNION SWITCH & SIGNAL CO., of Pittsburg, Pa., has brought a suit against the Philadelphia & Reading R. R. for infringement of patents in connection with the establishment of the Hall automatic block signal system.

THE DRESSEL RAILWAY LAMP WORKS, of New York city, has recently received an order from the Metropolitan West Side Elevated R. R., of Chicago, for equipping that line with electric head and side lights or classification signals, tail lamps, and switch lamps.

THE CHRISTOPHER DOUBLE POWER ENGINE CO., of Spartansburg, S. C., will establish a plant with machine shop 50 × 100 ft., foundry, boiler shop, etc., to manufacture engines on patents of J. H. Christopher. The incorporntors are W. D. Fowler, W. M. Bonar and J. H. Christopher.

THE SCHENECTADY LOCOMOTIVE WORKS, of Schenectady, N. Y., has an order for 3 eight-wheel passenger engines for the Delaware & Hudson R. R., and an order for 12 mogul freight engines, 5 eight-wheel passenger engines and 3 six-wheel switching engines for the Maine Central R. R.

THE BATH IRON WORKS, of Bath, Me., has a contract for a screw steamer 130 ft. long for the Maine Coast Navigation Co., to cost about $45,000. It will have a triple expansion engine, Scotch boilers, and the speed is to be 16 knots. The contract for the hull has been sublet to the New England Shipbuilding Co.

THE WELLS & FRENCH CO., of Chicago, Ill., has an order from the Hutchinson Refrigerator Car Co. for 200 refrigerator cars. Oregon pine will be used instead of yellow pine, and malleable iron instead of cast iron, in order to reduce the weight. The cars will be fitted with the California coupler, the Miner draft rigging, and the steel bolsters of the American Steel Foundry Co., East St. Louis, Ill.

THE MURRAY IRON WORKS CO., of Burlington, Ia., has built an iron erecting shop 116 ft. long, and enlarged the boiler shop to 104 × 126 ft. A 10-ton traveling crane of 30 ft. span is in the former building, and the latter has a 50-ton Morgan hydraulic riveter served by a crane with 35 ft. lift. The foundry has been equipped with a pneumatic molding machine, pneumatic hoists, and overhead carriers.

THE KALAMAZOO RAILROAD VELOCIPEDE & CAR CO., of Kalamazoo, Mich., has recently made the following shipments: To Australia, 18 of its No. 1 style of velocipedes, and 7 of its No. 6 style of cars; to Brazil, 29 of its No. 7 push cars and 6 of its No. 1892 velocipedes; to South Africa, 4 of its No. 8 inspection cars; these cars being duplicates of those shipped the same companies about six months ago.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has designed and erected a plate girder bridge on Laurel St., at Hartford, Conn., consisting of one span of 155 ft., with a roadway 36 ft. wide in the clear, and two sidewalks, each 8 ft. wide in the clear. The roadbed is entirely of concrete on buckle plates, no wood having been used. It has also recently completed an addition to the engine room of the Narragansett Electric Lighting Co., of Providence, R. I.

THE WESTINGHOUSE MACHINE CO., of Pittsburg, Pa., reports that its steam engines are finding a good market in foreign countries. Recent foreign orders completed include three compound engines of 150 HP. for Mexico, one 150-HP. compound engine of the latest type for Alaska, one of 200 HP. for Spain, one of 300 HP. for France, one of 150 HP. for Buenos Ayres, South America, and one of 800 HP. for Havana, Cuba, besides a number of smaller engines for Russia and other countries.

THE MUSKEGON BOILER WORKS CO., of Muskegon, Mich., reports that the co-partnership heretofore existing between Clifton D. Stevens and Edward Behrens, under the firm name of the Muskegon Boiler Works, has been dissolved, and that a co-partnership has been formed by Clifton D. Stevens, Edward Behrens, and Martin Dowd, under the firm name of the Muskegon Boiler Works Co., for the purpose of continuing the business as formerly conducted by the Muskegon Boiler Works.

THE ILLINOIS STEEL CO., of Chicago, Ill., with a capital stock of $30,000,000, earned only $30,607 in 1894, which was better than in 1893, however, when there was a deficit of $349,472. The annual report for 1893 showed $1,467,371 written off on account of the depreciation in the price of metal, etc., and the annual report for 1894, presented Feb. 13, says that, notwithstanding that enormous shrinkage, prices continued to decline during 1894. President Morse told the stockholders that the company's first steel plate had just been turned out of the mills at South Chicago.

THE HOLLY MFG. CO., of Lockport, N. Y., reports orders as follows: A horizontal compound, condensing, Gaskill, high duty pumping engine of 3,000,000 gallons daily capacity, for Elgin, Ill., to be in operation by June 15; a similar engine of the Holly-Gaskill type, 50,000,000 gallons capacity, for the San Jose Water Co., of San Jose, Cal.; and a third similar engine of improved pattern, 5,000,000 gallons capacity, for the Topeka Water Co., Topeka, Kan., to be placed in the new pumping station alongside the Holly-Gaskill engine of 5,000,000 gallons capacity now supplying the city with water.

THE FRED M. PRESCOTT STEAM PUMP CO. has recently established a plant at Milwaukee, Wis., and makes a specialty of pumps for deep-mine service. It has put in pumps of 700 gallons capacity per minute, against 700 ft. head in the Chandler mine at Ely, Minn., and the Norrie mine at Ironwood, Mich., and has recently shipped duplex compound pumping engines to the Newport Mining Co., of Ironwood, Mich., and the Pioneer Iron Co., of Ely, Minn. The latter has cylinders 16 × 24 and 30 × 24 ins., and plungers 9 × 24 ins., and its capacity is 600 gallons per minute against a head of 800 ft.

THE CHESTATEE PYRITES CO. has been organized at Atlanta, Ga., with a capital stock of $100,000, to work a mining property on the Chestatee River, near Dahlonega, Ga. The ore body is over a mile long, 300 ft. deep, and 9 ft. wide, and a working tunnel has already been started, from which 170 tons have been tested by the George W. Scott Mfg. Co., of Atlanta, and proved very satisfactory for the manufacture of sulphuric acid. A railway is to be built from Dahlonega, and a water power plant established for working the machinery by compressed air or electricity. Pres., George J. Baldwin, Savannah, Ga.; Vice-Pres., George W. Scott, Atlanta, Ga.

THE NATIONAL SWITCH & SIGNAL CO. have received orders from the West Side Construction Co., of Chicago, for two large interlocking plants, one of 64 levers, and one of 44 levers, for the Metropolitan Elevated Ry. These machines will be placed in steel towers. The 44-lever machine will operate signals guarding the double track rolling lift bridge over the Chicago River at Market St. Signals on both sides of the river will be operated from the machine. Owing to the use of electricity as the motive power, the introduction of the third, or conductor rail, and the novel design of the bridges, the ground work for interlocking will be of unique design. All signals will be operated by pipe connections, and the signals will show red for danger and green for safety.

NEW COMPANIES.—Genesee River & Lake Ontario Steamboat Co., Rochester, N. Y.; $20,000; Jacob D. Scott, W. F. Osborn and W. J. Wilcox.

Manufacturers' Supply & Tool Co., Syracuse, N. Y.; $10,000; A. G. Manz and Charles Manz.

Murphysboro Gaslight Co., Murphysboro, Ill.; $30,000; J. D. Peters, P. M. Post and W. C. Norman.

Clyde Wire Fence Co., Clyde, N. Y.; $20,000; P. W. Lovenway, M. W. Mead and R. T. Van Valkenburg.

Parrot Aerial Navigation Co., of Goldendale, Wash.; $50,000; E. D. Parrott, Almon Baker and W. J. White.

Cienega Lime Co., San Jose, Cal.; $100,000, commencing with $10,000; Henry Hart, O. W. Tupper and Geo. H. Ballon.

Avondale Ice & Cold Storage Co., Avondale, Pa.; $25,000; U. Grant Gifford, H. M. Carpenter, and Robert McKay.

St. Louis Quarry & Construction Co., East St. Louis, Ill.; $5,000; M. J. Hatfield, C. W. Watson and C. F. Schilling.

M. M. Buck Mfg. Co., St. Louis, Mo.; $250,000; railway supplies and general machinery; Myron M. Buck, A. H. Handlan and E. W. Handlan.

Automatic Turntable Co., Kansas City, Kan.; $100,000; Joseph B. Tinsley, of Anthony, Kan.; Thomas Donalon and Clarence L. Hogin, of Kansas City, Kan.

Jersey City Supply Co., Jersey City, N. J.; $50,000, commencing with $1,000; steam, plumbing and gas supplies; Robert Davis, Mark Curley and Michael F. Laverty.

Anderson Double Water Column Pump Co., Salt Lake City, Utah; $300,000; Anderson's deep mine pumps; George G. Bywater, Peter Anderson and John W. Snell.

Morgan & Booth Construction Co., Trenton, N. J.; $100,000, commencing with $3,000; Wm. Morgan and John Booth, of Trenton, N. J.; F. O. Pillsbury, Pittsfield, Mass.

Dykes Gas Engine & Pump Co., San Francisco, Cal.; $100,000, commencing with $2,000; A. J. Van Drake and John W. Curtis, of San Francisco; H. J. Dyke, of Berkeley, Cal.

San Diego Water Power & Electric Co., San Diego, Cal.; $1,000,000; 20,000-HP. plant to be driven by tidal wheels at False Bay; A. Krause, William H. Carlson and F. H. Dixon.

Fenton-White Construction Co., Hoboken, N. J.; $100,000, commencing with $1,000; general contracting business; M. J. Fenton, New York, N. Y.; J. J. White, Brooklyn, N. Y., and E. L. Richardson, Westfield, N. J.

Standard Mfg. & Construction Co., Jersey City, N. J.; $100,000, commencing with $1,000; railway and electrical supplies; John L. Bowles, 334 First St., Brooklyn, N. Y.; J. A. Webber, 454 Eleventh St., Brooklyn, N. Y., and H. W. Danty, Asbury Park, N. J.

ADVERTISEMENTS.

A news item or proposal advertisement in Engineering News is brought to the attention of more contractors and manufacturers of contractors' supplies than if published in any other paper in the world.

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